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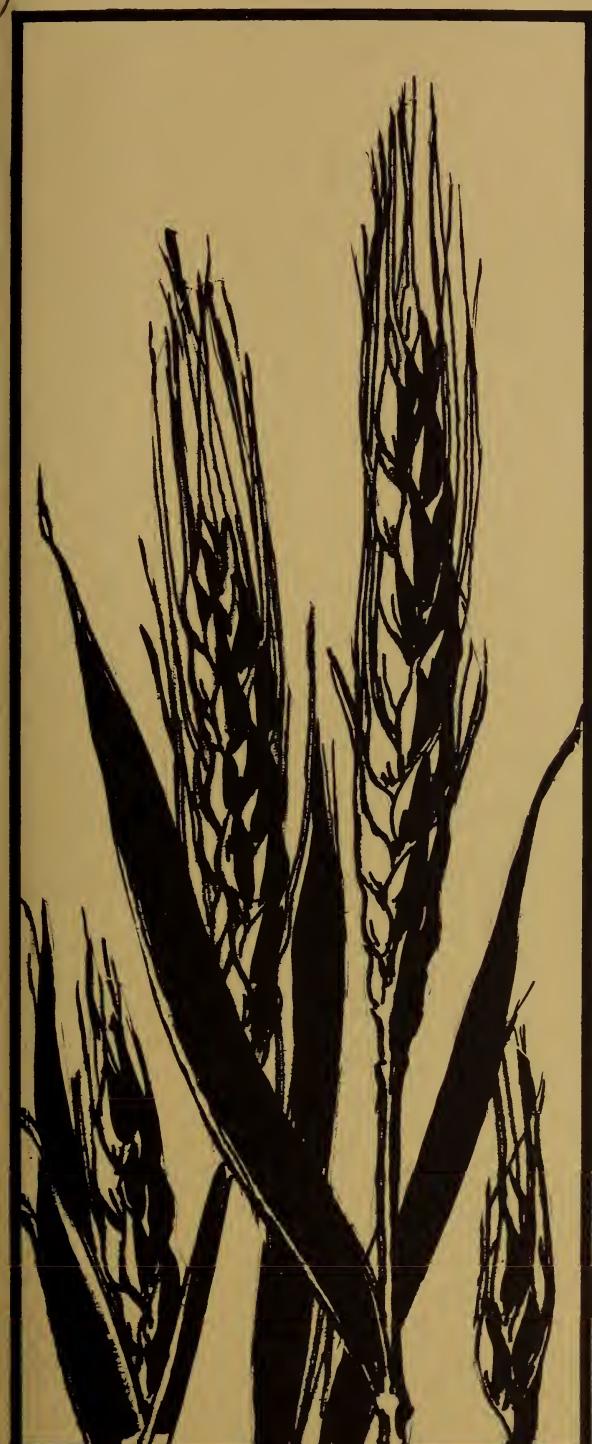
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FOREIGN AGRICULTURAL ECONOMIC REPORT NO. 59



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**ECONOMIC
PROGRESS
of AGRICULTURE
in DEVELOPING
NATIONS
1950-68**

ECONOMIC RESEARCH SERVICE
U. S. DEPARTMENT OF AGRICULTURE

ABSTRACT

Developing countries will need to achieve larger gains in agricultural productivity this decade than in the fifties or sixties if real incomes of farmpeople are to rise and agriculture is to make a significant contribution to national income growth. These countries, as a group, increased agricultural output 2.8 percent a year during the past two decades, about as rapidly as the industrial countries but only a little more than annual population growth of 2.5 percent. Output per farmworker grew less than 1 percent a year and output per hectare only 1.5 percent. Among the 54 countries studied, 17 countries increased agricultural output 4 percent or more a year, but output did not keep pace with population growth in 13 countries. Detailed studies of seven countries--Greece, Taiwan, Mexico, Colombia, Brazil, India, and Nigeria--show that many factors influence agricultural development. Developing countries will need expanding markets for farm products, large purchases of fertilizer and other nonfarm resources, development of land and water resources, and improvements in farm technology to accelerate economic progress in agriculture.

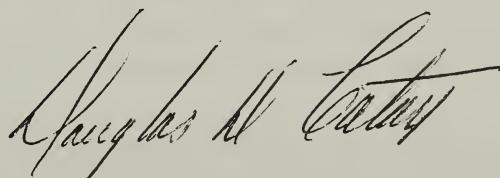
KEYWORDS: Developing countries, Economic growth and agriculture, Agricultural productivity, Agricultural policies.

FOREWORD

To provide better knowledge for planning and implementing country development programs, the Agency for International Development asked the Economic Research Service of the U.S. Department of Agriculture to conduct research on a project entitled "Factors Associated With Differences and Changes in Agricultural Production in Underdeveloped Countries." Phase 1 of the research compared and analyzed rates of growth in agricultural output and factors affecting them. It was reported in Changes in Agriculture in 26 Developing Nations, 1948 to 1963, Foreign Agr. Econ. Rpt. No. 27, Economic Research Service, U.S. Department of Agriculture, November 1965. This was augmented by Growth of Crop and Livestock Output in Selected Developing Nations, 1948 to 1965, ERS-Foreign 226, Economic Research Service, U.S. Department of Agriculture, July 1968.

Phase 2 of the research involved a detailed analysis of the specific relationship between factors and processes of change in agricultural output in seven countries: Greece, Taiwan, Mexico, Brazil, Colombia, India, and Nigeria. Agricultural economists from the Economic Research Service conducted these studies in cooperation with research organizations in each country.

This report reviews the progress of 54 developing countries in improving agricultural output and productivity during the 1950's and 1960's. It considers problems and policies for improving agriculture's performance in the 1970's. In addition, it summarizes findings from the seven detailed country studies.



Douglas E. Caton, Director
Office of Agriculture and Fisheries
Agency for International Development

PREFACE

The classification of countries into two categories--developing (or less developed) and developed (or industrialized)--is an arbitrary one based mainly on income or gross national product per capita. Countries commonly classified as developing include all those in Latin America, Asia, and Africa (except Japan and South Africa). Per capita annual incomes in these countries vary from less than \$100 in some to over \$500 in others. Obviously, countries called developing are on different steps of the economic development ladder.

Japan and a few eastern and southern European countries usually classified as developed were included among the 54 countries for which agricultural output growth rates from 1950 to 1968 are presented in this report. High agricultural output and low population growth rates helped them achieve large per capita income gains.

The seven countries studied in detail--Greece, Taiwan, Mexico, Colombia, Brazil, India, and Nigeria--differ widely in many respects: climate, soils, and other natural conditions affecting agricultural production; stage of economic development; resources, institutions, and experiences; kind and quantity of data and information available.

These differences account for some of the variations in the country chapters. Each study took into account the particular circumstances of each country, to permit more intensive analysis than would have been possible on a broader level of generalization.

These case studies of countries in varying stages of economic development disclose a considerable range in the effectiveness of their development efforts. However, they portray many of the physical and economic conditions found in other developing countries.

Raymond P. Christensen, Director, Foreign Development and Trade Division, Economic Research Service (ERS), directed the preparation of the report. Authors of individual chapters are cited in the text. Donald W. Dickson helped in the organization and presentation of the report.

Dr. Frank Parker, Agency for International Development (AID), provided expert advice and counsel. Special acknowledgment goes also to Dr. Douglas Caton (AID) for his continuing interest in the studies on which the report is based, and to numerous people in ERS, AID, and institutions abroad who supplied helpful information and assistance.

The studies reported here complement studies of the Food and Agriculture Organization (FAO) called Provisional Indicative World Plan for Agricultural Development (IWP). Although the ERS agricultural productivity studies and the IWP studies were carried out independently, FAO helped in the early stages of the studies reported here. FAO was concerned mainly with goals and policies from 1962 to 1985, while ERS was primarily interested in historical changes in agricultural output and productivity. Readers of this report will find it profitable to refer to the FAO reports, as well as to Partners in Development, report of the Commission on International Development of the International Bank for Reconstruction and Development (IBRD). Chapter IV of this report utilizes information from these studies.

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SUMMARY

Developing countries will need to achieve larger gains in agricultural productivity this decade than in the fifties and sixties if farm incomes are to rise and agriculture is to help national growth. These countries, as a group, boosted farm production as fast as the developed countries during the past two decades--about 2.8 percent a year. But rapid population growth in the developing countries absorbed most of the increase, resulting in a gain of only 0.3 percent a year per capita.

Agricultural output growth rates differ widely for the 54 developing countries studied. In 34 of the 54 countries, agricultural output expanded 3 percent or more per year; 17 of these countries had growth rates of 4 percent and above, demonstrating substantial progress. However, population grew faster than agricultural production in 13 countries. Estimated demand for agricultural products advanced more than production in 32 of 45 countries.

On an overall basis, growth in crop area and higher yields were equally important as sources of increased crop output in the developing countries. Crop output per hectare of crops grown increased about 1.5 percent a year. But agricultural output per farmworker grew less than 1 percent a year.

With rising population growth rates, farming has had to provide employment for increasing numbers of workers despite net migration to towns and cities in most countries. Even though productivity gains per worker have been substantial in many countries, they generally have not been large enough to improve relative incomes of rural people and at the same time permit large net transfers of capital from agriculture to other sectors. Despite some improvement in the last two decades, per capita incomes of farmpeople still average only one-fourth to one-half as high as those of nonfarmpeople.

Much larger gains in agricultural productivity will be required in developing countries in the 1970's if real incomes of farmpeople are to rise and agriculture is to make a significant contribution to national income growth. To expand agricultural output 4 percent a year, crop yields must rise about 3 percent a year (twice as fast as during the 1950's and 1960's, or about the same rate as in the

developed countries). Arable area can grow 0.7 percent a year by bringing additional land under cultivation. Harvested area can grow 1.5 percent a year by greater cropping intensity.

Developing countries will need to find ways of increasing agricultural output per worker, while total numbers of workers increase and arable land per worker decreases. The number dependent upon farming for employment is projected to increase about 1.7 percent a year. If total agricultural output increases 4 percent a year, agricultural output per farmworker would rise 2.3 percent a year--much more rapidly than in most developing countries during the 1950's and 1960's, but only enough to achieve modest gains in real incomes for farmpeople. To achieve such growth in agricultural output, developing countries will need expanding markets for farm products at incentive prices, large purchases of fertilizer and other nonfarm inputs, development of land and water resources, and improved agricultural technology.

The seven countries studied intensively vary widely in size, stage of economic development, agricultural resources, and farm technology, but there were important similarities in development. Agriculture is a major sector in all seven countries and the primary source of foreign exchange and industrial raw materials in most. All countries had difficulty providing productive employment opportunities for increasing numbers of workers. Many farmpeople migrated to urban areas. All countries achieved substantial growth from 1950, with gross domestic product tripling in Taiwan, at least doubling in Mexico, Greece, and Brazil, and nearly doubling in Colombia and India.

Greece increased agricultural output 4.6 percent a year from 1950-68. Gross domestic product rose 6 percent a year while population grew at the rate of 0.8 percent a year. Agricultural output per farm person rose 5 percent a year. Increased yields accounted for 76 percent of the growth of agricultural output. This was accomplished by improving irrigated land, rapidly increasing the use of nonfarm-produced inputs, extensive research--particularly in cotton, wheat, and corn--and the doubling of capital investment. Development of the Agricultural Bank and cooperatives also contributed to overall agricultural growth.

Taiwan increased agricultural output 4.5 percent a year with a population growth of 3.3 percent. National income rose nearly twice as fast as agricultural output. Cultivated land could not be expanded. All of the growth in crop output was from farming irrigated land more intensively. From 1940 to 1965, the number of farms nearly doubled and land per farm dropped from an average of 2 hectares to 1.05. During this period, output per hectare doubled.

Rapid growth in livestock and poultry production could be attributed largely to imported feeds. Domestic demand for farm products accelerated as nonfarm population grew 4.2 percent a year and real per capita income 4.4 percent a year. Despite a large net migration from rural to urban areas, farm population went up 2.4 percent a year and agricultural output per worker rose 2.1 percent a year.

Mexico's agricultural output grew 5.1 percent a year while population rose 3.3 percent. The rapid expansion of agricultural production from 1940 to 1965 was primarily due to increased employment of purchased inputs (including fertilizer and better crop varieties), land, livestock capital, and hired labor, all of which were about equal in importance. The Government instituted two major programs. One was the expansion of irrigated land eventually affecting over 2 million hectares. Inputs used on this land were those associated with modern agriculture, but such inputs were of little significance on most of the land outside irrigation districts. The second program was one of land reform which affected 29 percent of the arable land and 43 percent of the cropland. Nonagricultural population increased 5.2 percent a year as many farmpeople moved to towns and cities. However, agricultural population increased 1.5 percent a year. Agricultural output per farm person rose about 3.5 percent a year.

Colombia increased agricultural output 3.3 percent a year, a little more rapidly than total population, and gross domestic product grew at 4.7 percent a year. Lower coffee prices after 1956 reduced foreign exchange earnings, and economic growth slowed for several years with rising unemployment. The economic outlook improved near the end of the 1960's. Agricultural population increased only 1.3 percent a year and output per farmworker grew at 2 percent. Increases in area and crop output per hectare were about equally important in explaining the growth in agricultural output. Most of the expansion was in commercial crops, especially cotton, rice, and sugarcane, with the adoption of relatively modern technology on large farms. Broader participation in agricultural output expansion could be obtained by stressing selected non-traditional inputs and assisting small farmers to expand and modernize.

Brazil increased agricultural output about 4 percent a year, mainly by expanding cultivated area, but it has the potential to double area cultivated. Agricultural production grew more rapidly than population in the 1950's and 1960's, but crop yields remained low and traditional practices were followed with low levels of fertilization. Human labor is the only source of power on three-fourths of the farms. Agricultural output increased rapidly enough

to meet rising demands for farm products resulting from population and income growth. Agriculture has remained the principal economic activity and source of foreign exchange earnings in Brazil with coffee being the major export. Nonfarm population grew 5 percent a year and farm population about 1.5 percent a year. Agricultural output per farm person rose 2.5 percent a year.

India increased its agricultural output 3.2 percent a year from 1947 to 1964 at a rate approximately 0.7 percent greater than population growth. During this period food grain production increased 30 million tons from a base of 60 million tons. Crop output declined abruptly with unfavorable weather in 1965 and 1966, but it rose to a record high in 1969 with widespread use of new varieties of wheat and rice on irrigated land. Growth in crop output per hectare and increases in land area were about equally important in explaining growth in crop output. Higher yields from 1950-64 were achieved largely with superior crop varieties; adaptation of improved farm technologies was limited. Agriculture is extremely important to the Indian economy, providing employment for 70 percent of the labor force, half the gross domestic product, and raw materials for half the industrial output. India has potentials for increasing agricultural output 4 to 5 percent a year in the next decade. But achievement of these potentials will require irrigation improvements, additional supplies of fertilizer and other nonfarm inputs, better pest control, additional improved crop varieties, and incentive prices to farmers. India will continue to face difficult problems in finding productive work for its growing agricultural labor force.

Nigeria increased its output of basic food crops at about the same rate as total population. In addition, it expanded output of export crops which are produced almost entirely by peasant producers. Except for the planting of some improved varieties and the spraying of cocoa, application of modern technology is very limited. Fertilizer usage is 0.5 lb. of nutrients or less per acre, and in 1967 there were only 256 tractors in the country. The bush fallow system prevails, and livestock and trees are the major capital assets. Nigeria can increase output and has large potentials for expanding agricultural production by bringing new land under cultivation.

ECONOMIC PROGRESS OF AGRICULTURE IN DEVELOPING NATIONS, 1950-68

Foreign Development and Trade Division
Economic Research Service

Chapter I. WHY AGRICULTURE IS IMPORTANT

By R. P. Christensen

Few nations achieve high per capita incomes without first achieving substantial gains in agricultural productivity. Some developed countries like the United Kingdom, West Germany, and Japan now rely heavily on agricultural imports. But large increases in agricultural productivity during early stages of economic development helped make their industrial growth possible. In a few developing countries, exploitation of petroleum, minerals, or other natural resources has led to large income gains for a small part of the total population. But where these gains have not been accompanied by improvements in agricultural productivity, neither the income nor the lives of those dependent on farming have been much improved.

Economic growth in the low-income countries depends heavily on improving the economic performance of the agricultural sector just as it did at earlier stages of economic growth in the high-income countries. In most countries where per capita incomes average less than \$300 a year, 40 to 80 percent of the total labor force is employed on farms, and farm products account for 30 to 60 percent of gross national product (figs. 1 and 2). ^{1/} But similar conditions prevailed not long ago in Japan, Israel, and other countries where economic growth

has been rapid in the last 20 years. Because agriculture is the dominant economic sector in most low-income countries, increased productivity in agriculture is essential to per capita income growth.

A major question facing the developing countries today is: Can agricultural productivity increase rapidly enough to meet the needs of the expanding population, as well as satisfy requirements for national economic growth?

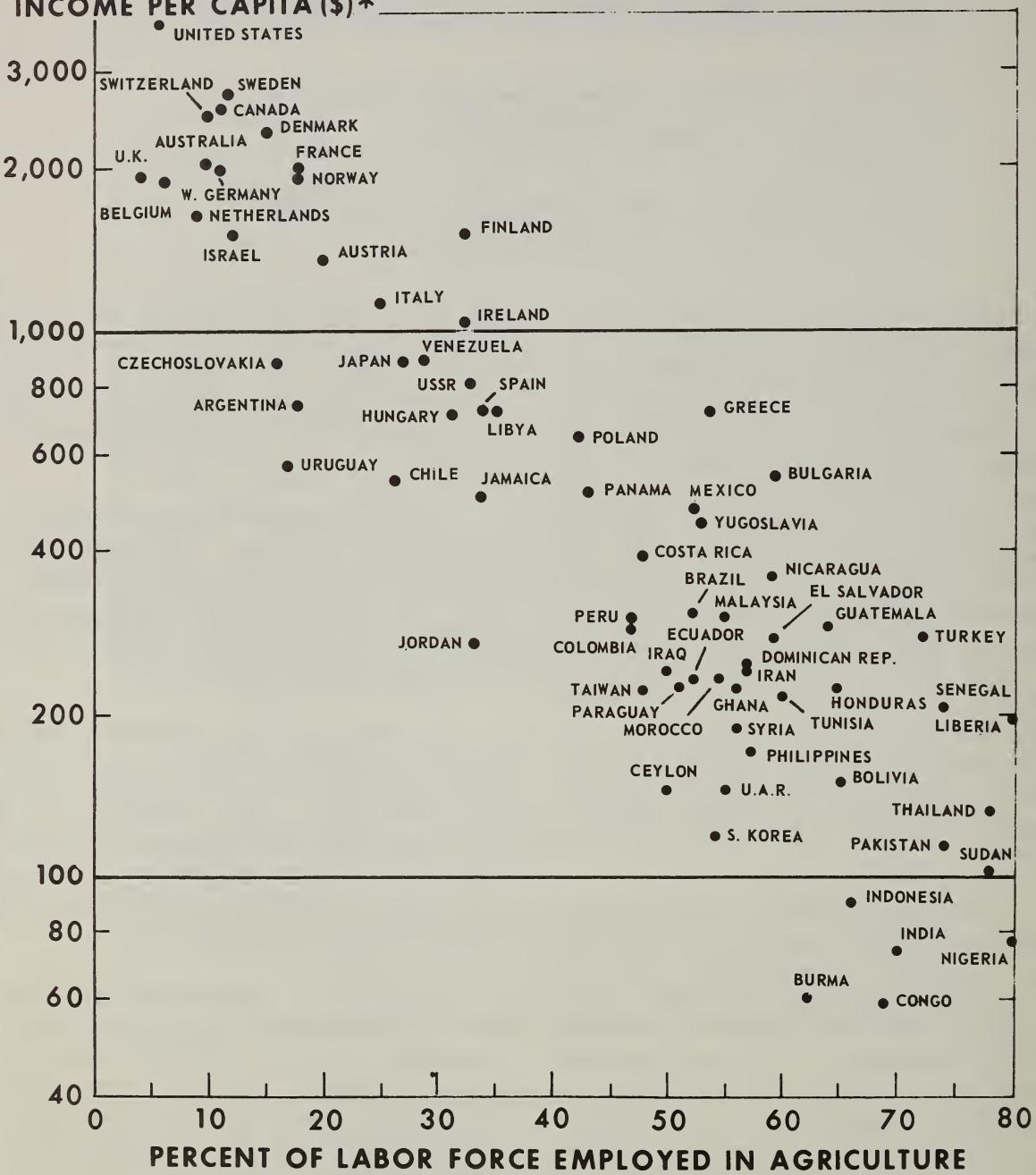
In many of these countries, population is growing 2 to 3 percent a year. Some countries are growing even faster. Population growth rates of many are more than double those that prevailed in Western Europe and Japan during the years when they were beginning to move upward on the economic development ladder.

Supplies of agricultural products must increase about 4 percent a year in developing countries to meet expanding domestic demand resulting from population growth and rising incomes and to avoid price inflation that would disrupt industrial growth. Even larger gains will be needed in many countries to provide more nutritionally adequate diets.

^{1/} U.S. dollars and metric tons are used throughout this report unless otherwise indicated.

INCOME PER CAPITA, 1967, AND PERCENT OF LABOR FORCE IN AGRICULTURE, 1965, DEVELOPED AND LESS DEVELOPED COUNTRIES

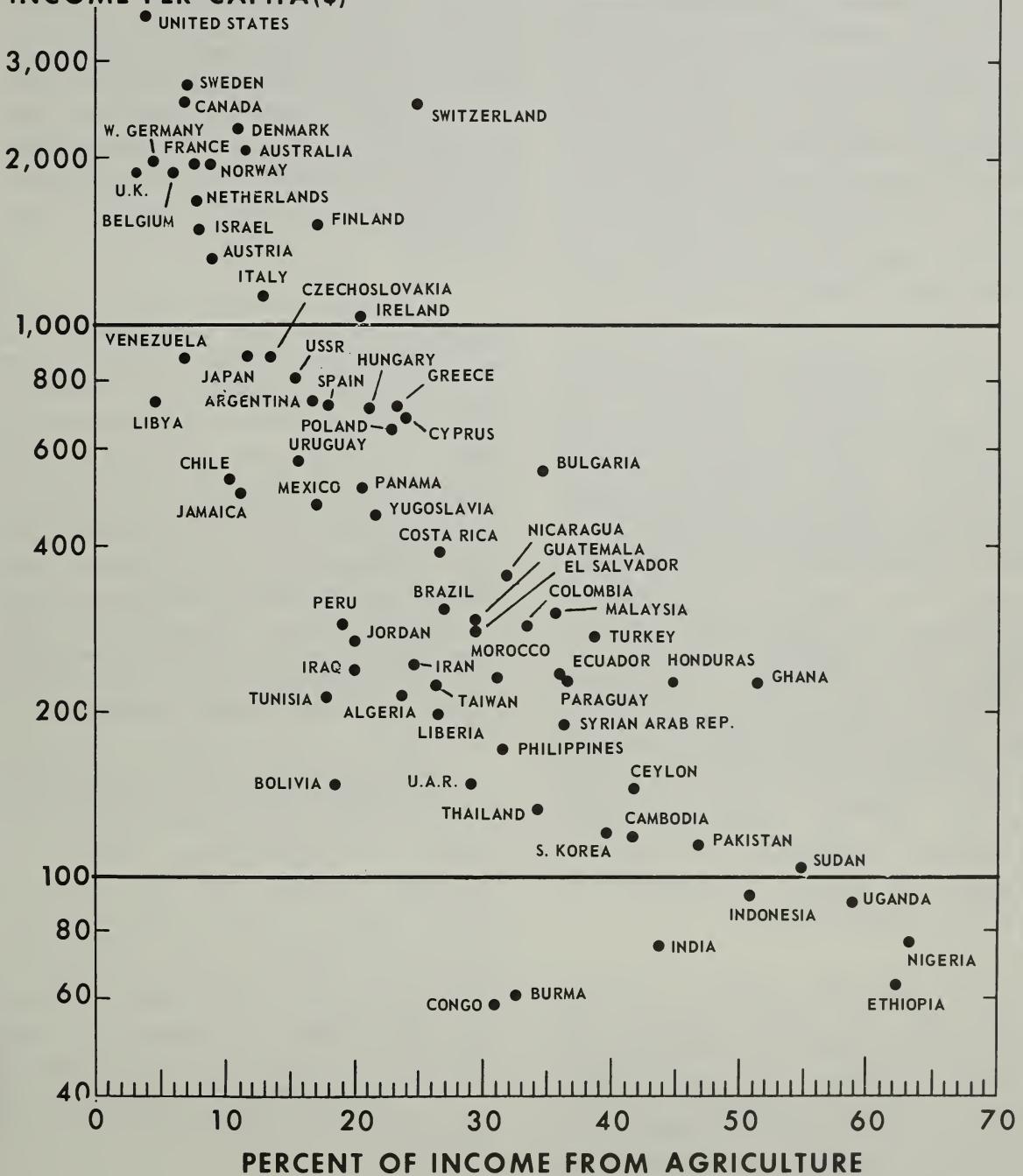
INCOME PER CAPITA (\$)*



*GROSS NATIONAL PRODUCT PER CAPITA, 1966 DOLLARS.

INCOME PER CAPITA, 1967, AND PERCENT OF INCOME FROM AGRICULTURE, 1965, DEVELOPED AND LESS DEVELOPED COUNTRIES

INCOME PER CAPITA(\$)*



* GROSS NATIONAL PRODUCT PER CAPITA, 1966 DOLLARS.

Agricultural output gains of 4 to 5 percent a year are more than twice as high as those achieved in most developed countries for periods of a decade or longer. For example, during the 1870-1920 period, when agriculture made large contributions to U.S. economic growth, total agricultural output increased at a compound rate of 2.2 percent a year. If population growth slowed, this would reduce the rates of increase in agricultural output required for economic development. However, population growth in most developing countries is not likely to decline much in the next decade.

If agriculture is to contribute effectively to national economic growth, expansion in agricultural production must be achieved largely through increased productivity or efficiency. Greater productivity per person employed in agriculture would provide an economic surplus that can be reinvested in agriculture, used to improve the welfare of rural people, or transferred out of agriculture to provide capital for industrial growth. This productivity must be achieved with relatively small amounts of capital from other sources, since capital is in such high demand in all sectors. The ultimate hope, of course, is that technological advances can be introduced into the agricultural economies of developing countries to achieve significant productivity breakthroughs.

As countries achieve economic growth and per capita incomes rise, agriculture accounts for a declining share of total employment and gross national product (GNP). For example, in countries with per capita incomes of \$1,000 or more a year, farming usually accounts for less than 25 percent of total employment, and farm products for less than 15 percent of GNP.

As per capita incomes rise, consumers spend a smaller share for food and more for other things. Demand rises more for nonfarm products and services than for farm products; output rises more rapidly in other sectors than in agriculture. The share of total employment on farms also declines because capital goods from nonfarm sources are substituted for farm labor. As economic growth occurs, farm labor becomes more expensive, and capital goods more abundant.

However, agriculture still is a major economic sector in most developing countries, accounting for a large share of total employment and GNP. In addition, a large share of the economic activity in these countries is concerned with transporting, storing, and processing raw materials from agriculture, or supplying fertilizer, pesticides, tools, machines, and other materials for use in farm production. Approximately 70 to 80 percent of the manufacturing industries in many developing countries are either based on raw materials from agriculture or produce materials for use in farm production.

Economic growth in the agricultural and nonagricultural sectors is interrelated in several ways. Agriculture depends upon growth of nonagricultural sectors for expanding markets for farm products, capital inputs to apply improved agricultural technology, and employment opportunities for workers not needed in farming. Nonagricultural sectors depend upon agriculture for markets for many industrial products and services, supplies of raw materials, and workers to fill many of the jobs created with industrial growth.

Gains in agricultural output and GNP in the developing countries since 1950 are

not as closely related as might be expected (fig. 3). GNP increased about 1.5 percent a year for each 1-percent increase in agricultural output, but individual countries vary widely around this average. Agricultural production rose more rapidly than GNP in a few countries like Nicaragua and Ecuador, where agricultural exports went up greatly. A few countries like Iran, Iraq, Chile, and the United Arab Republic had much higher rates of growth in GNP than in agricultural output. However, some of these countries rely heavily on mineral and petroleum resources.

Despite the large net migration from farms to urban areas in most developing countries since 1950, per capita incomes of farmpeople still average less than half the rest of the economy. Low incomes in agriculture indicate that farmpeople do not share equally with urban people in national income. They also suggest that labor productivity in agriculture is low. Of course, there are wide differences in labor productivity within agricultural sectors of most developing countries. Many have well-developed, market-orientated production for some crops, especially export crops, where productivity averages fairly high. However, much farming in these countries is close

to subsistence levels, carried out with traditional methods.

Low rates of growth in productivity and incomes of farmpeople retard growth in demand for industrial products and services. This in turn slows growth of nonagricultural sectors. Similarly, low growth rates in agricultural output, especially raw materials required for rapid industrial development, slow growth of nonagricultural sectors.

Prospects of employment opportunities in nonagricultural sectors have led farmpeople to migrate to urban areas. This migration contributes to higher per capita incomes of people who remain on farms. However, net migration of farmpeople to urban areas already has been more than enough to fill new jobs created in nonagricultural sectors. Most cities and towns in developing countries now have large pools of unemployed or underemployed people.

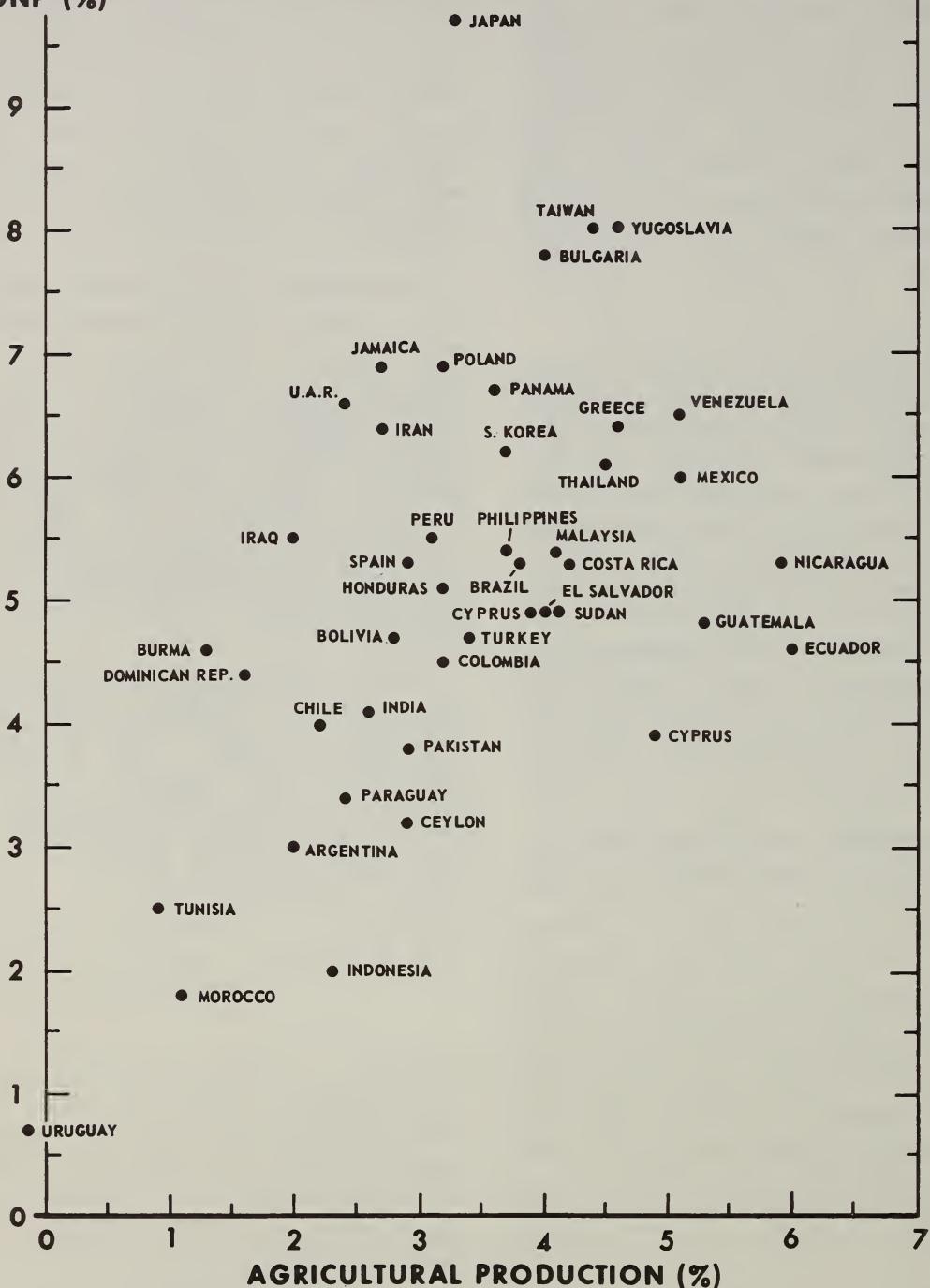
Farm population can be expected to rise in the 1970's unless population growth is greatly reduced. How to improve productivity and income levels for increasing numbers of farmpeople will be a major problem of the developing countries in the years ahead.

GROSS NATIONAL PRODUCT AND AGRICULTURAL PRODUCTION

Annual Compound Growth Rates, Less Developed Countries, 1950-68

GNP (%)

● JAPAN



U. S. DEPARTMENT OF AGRICULTURE

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Figure 3

Chapter II. AGRICULTURE'S PERFORMANCE IN THE DEVELOPING COUNTRIES

By John R. Schaub

Agriculture's performance in a country can be measured in several different ways. Here, it is measured by compound annual growth rates in: total agricultural production; agricultural production per capita of the total population; total agricultural production compared with total domestic demand for farm products; crop output per hectare of crops grown; and agricultural production per farmworker or per farm person.

COMPARISON OF DEVELOPING AND DEVELOPED COUNTRIES

Since the mid-1950's, total agricultural production increased 2.8 percent a year in both developing and developed countries (fig. 4). Output in the developing countries moved upward steadily, except for 1966 when droughts in south Asia caused a decline. Total agricultural output in developing countries reached a record high in 1969 (88). ^{2/}

Although total population rose rapidly in the developing countries, per capita agricultural production went up only slightly. In the developed countries per capita agricultural production increased 1.6 percent a year.

Population growth in developing countries increased from about 1 percent a year in the early 1900's to about 2

^{2/}Underscored numbers in parentheses refer to items in literature cited, p. 172. Figures 6-12 are grouped at the end of the chapter.

percent a year in 1955 and 2.6 percent in 1968. But population has grown only 1.2 percent a year in developed countries.

As a source of increased grain production in developing nations, higher yields have been as important as expansion in area harvested (fig. 5). From 1954 to 1967, grain yields increased 22 percent, or 1.5 percent a year (table 1).

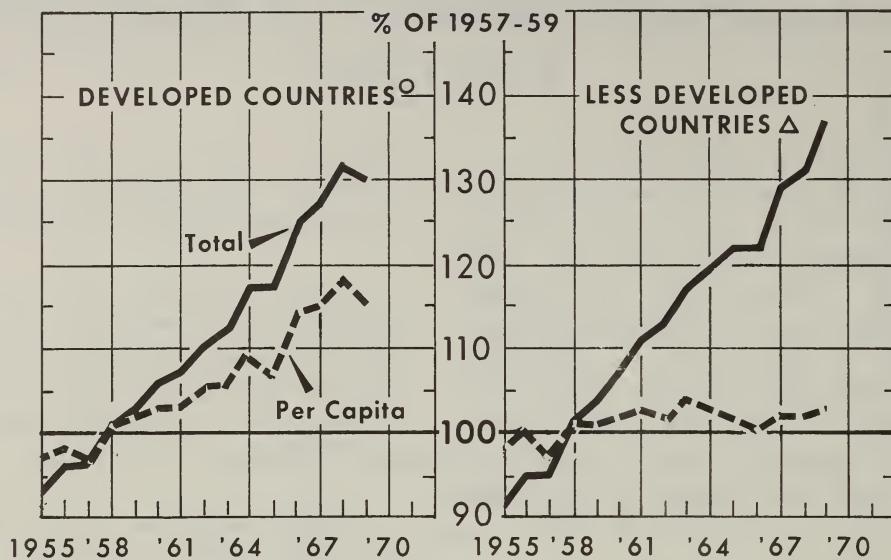
But increases in crop yields were far more rapid in developed countries. From 1954 to 1967, grain yields increased 48 percent, or about 3 percent a year, accounting for all the growth in grain production in these countries.

Grain is the major food crop in the developing countries. It is a good indicator of change in total food production. Growth rates for total grain production are only slightly higher than growth rates for total agricultural production. Grain production from 1967 to 1969 continued to increase at about the same rate as the long-term trend.

Despite a steady rise since 1954, grain yields in developing countries remain lower than those in developed countries. For example, in 1967 yields averaged only about 1.2 tons per hectare in developing countries, compared with 2 tons in developed countries (table 1). The high yields achieved in the developed countries indicate the potential for increasing yields in the developing countries.

Differences between developing and developed countries in agricultural output

WORLD AGRICULTURAL PRODUCTION



○ NORTH AMERICA, EUROPE, USSR, JAPAN, REPUBLIC OF SOUTH AFRICA, AUSTRALIA, AND NEW ZEALAND.

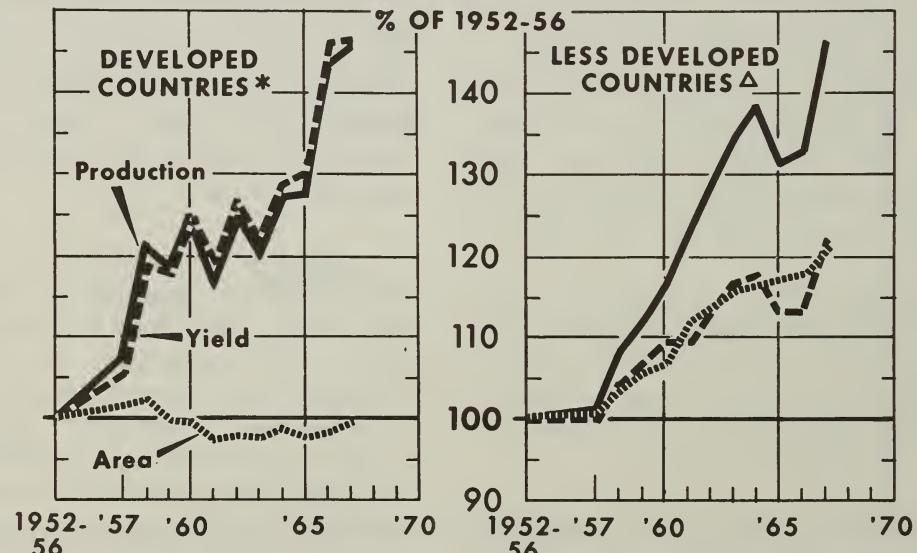
△ LATIN AMERICA, ASIA (EXCEPT JAPAN AND COMMUNIST ASIA), AFRICA (EXCEPT REPUBLIC OF SOUTH AFRICA).

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Figure 4

WORLD GRAIN PRODUCTION



* NORTH AMERICA, EUROPE, JAPAN, USSR, REP. OF SOUTH AFRICA, AUSTRALIA AND NEW ZEALAND.

△ LATIN AMERICA, ASIA (EXCEPT JAPAN AND COMMUNIST ASIA), AFRICA (EXCEPT REP. OF SOUTH AFRICA).

SOURCE: COMPUTED FROM DATA IN FAO PRODUCTION YEARBOOKS.

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Figure 5

Table 1.--Area, yields, and production of all grains, developing and developed countries, 1954 and 1967 1/

Item	Area	Yield	Production
	Mil. ha.	Tons/ha.	Mil. tons
Developing countries:			
1954 2/	241	0.97	234
1967	291	1.18	343
Change, 1954-67	21	22	46
Annual growth	1.5	1.5	3.0
	Mil. ha.	Tons/ha.	Mil. tons
Developed countries:			
1954 2/	300	1.40	418
1967	298	2.05	610
Change, 1954-67	-2	47	44
Annual growth	- .1	3.0	2.9

1/ Computed from (28). Developed countries include Europe, Soviet Union, Canada, United States, Japan, Republic of South Africa, and Oceania. Developing nations are in Asia, Africa, and Latin America, and Mainland China. 2/ Data for 1954 are averages for 1952-56.

per capita of farm population are much greater than differences in crop yields. In 1967, grain production per capita of farm population averaged only 322 kilograms in developing countries, compared with nearly 2,800 kilograms in developed countries (table 2). These wide differences in productivity help to explain the broad divergence in per capita incomes between the two groups of countries. Per capita income in developing countries averaged only about \$185 in 1967, about one-tenth as high as in the developed countries.

Agricultural production per worker has increased in developing countries, but not nearly as rapidly as in developed countries. Changes in agricultural production per capita of agricultural population and in grain production per capita of agricultural population indicate approximately how output per farmworker has changed. Agricultural production per capita of agricultural population increased only 0.4 percent a year in developing countries since the mid-1950's, compared with 4.4 percent a year in the developed countries. Grain production per capita of agricultural population increased about 0.6 percent a year from 1954 to 1967 in developing countries, compared with about 4.7 percent a year in developed countries.

Total farm population increased about 2.4 percent a year from 1954 to 1967 in developing countries, but decreased 1.6 percent a year in developed countries. Obviously, it is far more difficult to increase output per worker when the total number of workers is growing.

The relatively low growth rate in output per person in agriculture in the developing countries indicates that growth in agricultural productivity has not been sufficient to improve per capita income in agriculture significantly. It also means that agriculture could not supply much capital for nonagricultural sectors without depressing per capita incomes of farm-people.

It is noteworthy that the changes described above are for the developing countries as a group. They are heavily influenced by populous countries. Many developing countries with smaller populations have achieved significant gains in output per worker in agriculture.

Table 2.--Population and production of all grains per capita of total population and of farm population, developing and developed countries, 1954 and 1967 1/

Item	Unit	1954	1967	Change, 1954 to 1967	
				Total	Annual
				Percent	
Developing countries:					
Total population	Million	1,204	1,663	38	2.5
Farm population	Million	783	1,065	36	2.4
Total grain production	Mil. tons	234	343	46	3.0
Grain production:					
Per capita of total population	Kilograms	194	206	6	.5
Per capita of farm population	Kilograms	299	322	8	.6
Developed countries:					
Total population	Million	888	1,040	17	1.2
Farm population	Million	273	220	-19	-1.6
Total grain production	Mil. tons	418	610	46	3.0
Grain production:					
Per capita of total population	Kilograms	471	587	25	1.7
Per capita of farm population	Kilograms	1,533	2,768	81	4.7

1/ Computed from (28). Developed countries include Europe, Soviet Union, Canada, United States, Japan, Republic of South Africa, and Oceania. Developing nations are in Asia, Africa, and Latin America, and Mainland China.

AGRICULTURAL PRODUCTION

GROWTH RATES

Compound annual growth rates in total agricultural production since 1950 differ widely among the 54 developing countries:

Annual growth rate Percent	Countries Number	Countries	
		Percent	Number
5 or more	6		
4-4.9	11		
3-3.9	17		
2-2.9	14		
1-1.9	3		
Less than 1	3		

Seventeen countries increased total agricultural production at compound

annual rates of 4 percent or more. Countries with relatively high growth rates were distributed throughout all regions (table 3).

Factors other than population density apparently are responsible for differences in growth rates for agricultural output. Some countries that are densely populated as well as some that are sparsely populated achieved high growth rates.

Total agricultural output increased more than population in most countries. In 22 of the 54 countries, agricultural production per capita of total population increased 1 percent or more a year. However, agricultural output did not keep pace with population growth in 13 of the 54 countries.

Table 3.--Compound annual growth rates in agricultural production, population, and per capita agricultural production, 54 countries, selected periods, 1950-68 1/

Country and region	Period	Agricultural production	Population	Per capita agricultural production	Country and region	Period	Agricultural production	Population	Per capita agricultural production
Percent - - -									
<u>Latin America</u>					<u>West Asia</u>				
Costa Rica	1950-68	4.2	3.8	0.4	Cyprus	1950-68	4.9	1.3	3.6
Dominican Republic	1950-68	1.6	3.6	-2.0	Iran	1954-68	2.7	2.9	- .2
El Salvador	1950-68	4.0	3.0	1.0	Iraq	1954-68	2.0	2.8	- .8
Guatemala	1950-68	5.0	3.4	1.6	Israel	1950-68	9.3	3.9	5.4
Honduras	1950-68	3.2	3.2	0	Jordan	1952-68	3.5	2.8	.7
Jamaica	1950-68	2.7	1.8	.9	Lebanon	1950-68	3.6	2.7	.9
Mexico	1950-68	5.1	3.3	1.8	Syria	1950-68	3.1	3.2	- .1
Nicaragua	1950-68	5.9	3.1	2.8	Turkey	1950-68	3.4	2.7	.7
Panama	1950-68	3.6	3.1	.5	Total	1954-68	3.3	2.8	0.5
Trinidad and Tobago	1950-68	2.4	3.0	-.6	<u>Far East</u>				
Argentina	1950-68	2.0	1.7	.3	Burma	1954-68	1.3	1.9	-0.6
Bolivia	1950-68	2.8	2.2	.6	Cambodia	1954-68	3.6	2.6	1.0
Brazil	1950-68	3.8	3.0	.8	Ceylon	1954-68	2.9	2.4	.5
Chile	1950-68	2.2	2.4	-.2	India	1950-68	2.6	2.2	.4
Colombia	1950-67	3.3	3.2	1	Indonesia	1950-68	2.3	2.2	.1
Ecuador	1950-68	6.0	3.2	2.8	Japan	1950-68	3.3	1.0	2.3
Guyana	1950-68	3.8	2.8	1.0	Korea	1954-68	3.7	2.8	.9
Paraguay	1950-68	2.4	2.6	-.2	Malaysia	1954-68	4.1	3.1	1.0
Peru	1950-68	3.1	2.7	.4	Pakistan	1954-68	2.9	2.4	.5
Uruguay	1950-68	-.1	1.4	-1.5	Philippines	1954-68	3.7	3.3	.4
Venezuela	1950-68	5.1	3.7	1.4	Taiwan	1950-68	4.4	3.2	1.2
Total	1950-68	3.3	2.8	0.5	Thailand	1950-68	4.5	3.3	1.2
					Total	1954-68	2.7	2.2	0.5
Percent - - -									
<u>Africa</u>					<u>Africa</u>				
					Libya	1954-68	3.4	3.3	0.1
					Malagasy Republic	1950-68	-2.4	2.4	-4.8
					Morocco	1950-68	1.1	2.8	-1.7
					Senegal	1950-68	4.3	2.4	1.9
					Sudan	1950-68	4.1	2.9	1.2
					Tunisia	1950-68	.9	2.1	-1.2
					United Arab Republic	1950-68	2.4	2.5	-.1
					Total	1950-68	2.7	2.4	0.3

1/ Computed from data compiled by the Foreign Regional Analysis Division, Economic Research Service. Growth rates for agricultural production and population were computed by least squares with the dependent variable expressed in logarithms. Per capita agricultural production growth rates were computed by subtracting population growth rate from agricultural production growth rate. Slope coefficients were not statistically significant at the 5 percent level for agricultural production in Uruguay, Malagasy Republic, and Tunisia. Regional growth rates were calculated from indices that included some countries not listed on this table. Data for Colombia are from (6).

Total agricultural production in Latin America increased 3.3 percent a year. But population grew 2.8 percent a year, so that per capita agricultural output increased only about 0.5 percent a year. Growth rates over the entire period vary widely among countries (figs. 6 and 7). El Salvador, Guatemala, Mexico, Nicaragua, Ecuador, Guyana, and Venezuela increased per capita agricultural production 1 percent or more a year. Population increased faster than agricultural production in the Dominican Republic, Trinidad and Tobago, Chile, Paraguay, and Uruguay.

Growth rates in agricultural output were relatively high in the countries of southern and eastern Europe, compared with the low rate of growth of population and the very high per capita agricultural output (fig. 8).

Agricultural production and population growth rates in West Asia were about as high as those in Latin America (fig. 9). However, production in some West Asian nations fluctuated widely from year to year. Per capita agricultural production increased greatly in Israel, but declined in Iran, Iraq, and Syria.

In the Far East, agricultural production increased 2.7 percent a year, population 2.2 percent a year, and per capita agricultural production 0.5 percent a year. Despite high population growth rates, Malaysia, Taiwan, and Thailand increased total agricultural production 4 percent or more a year, and per capita agricultural production 1 percent or more a year. Serious droughts reduced agricultural production in India in 1965 and 1966, and in Pakistan in 1966 (fig. 10). But production recovered in these countries in 1967 and 1968 with favorable weather conditions and increased use of new high-yielding grain varieties. Taiwan,

Thailand, Korea, and the Philippines had much higher agricultural output growth rates than India and Pakistan (fig. 11). Some large areas within India and Pakistan had very high agricultural output growth rates, however.

Agricultural output rose more than population in Senegal and Sudan, but output lagged behind population growth in the United Arab Republic, Morocco, and Tunisia (fig. 12).

GROWTH IN DEMAND FOR AGRICULTURAL PRODUCTS

In general, agricultural output in developing nations did not keep pace with growth in domestic demand for agricultural products.

Growth in domestic demand for agricultural products depends upon changes in per capita real income and population. Growth rates in per capita real income vary even more widely than population growth rates (table 4). For example, annual per capita real income declined in Uruguay, Indonesia, and Morocco, but rose more than 4.5 percent a year in Jamaica, Jordon, Israel, and Taiwan.

Estimates of growth in domestic demand for agricultural products were made for 45 of the 54 countries. Lack of data on real per capita income changes were not available for the remainder.

In the estimates of growth in domestic demand for agricultural products presented here, coefficients of the income expenditure elasticity of demand for agricultural products were assumed to vary with per capita income levels. For example, it was assumed that the income elasticity of demand for

agricultural products would vary from 0.3 for countries with per capita incomes of \$600 or more in 1966 to 0.7 for countries with per capita incomes of less than \$200. Per capita growth rate multiplied by the coefficient of income elasticity of demand for agricultural products gives the growth rate in per capita demand. Adding the growth rate in per capita demand to the population growth rate gives the growth rate in total domestic demand for agricultural products. Estimates of growth rates in total domestic demand can only be approximate, because it is not known whether the assumed coefficients of income elasticity of demand are applicable in all countries. Also, the estimates assume no changes in relative prices for different agricultural products.

In most countries, population growth was more important than per capita income growth in increasing total domestic demand for agricultural products. The share of the growth in total domestic demand attributable to per capita income growth equaled or exceeded 50 percent in only 11 of the 45 countries (table 4). Five of these countries are in southern and eastern Europe where population growth was low. Nevertheless, increases in demand resulting from per capita income gains are important. As per capita incomes and consumption levels rise, people consume more of the expensive foods (livestock products, fruits, and vegetables). Composition of farm production must change to meet these needs.

The estimates show that total domestic demand for agricultural products increased more than agricultural output in 33 of the 45 countries. However, it should be emphasized that this is a general picture and does not imply a deficit in all commodities. In 15 countries, production deficits were 1 percent or more

a year. Although these deficits are not large, when compounded over the 18-year period from 1950 to 1968, they indicate that agricultural production increased about 25 percent less than necessary to keep pace with growth in domestic demand.

Growth in markets for farm products resulting from growth of nonagricultural sectors obviously has been a major factor affecting agricultural output growth rates. The fact that agricultural output growth did not keep pace with growth in domestic demand for farm products in many countries suggests that lack of markets or demand was not the critical factor limiting agricultural output growth, although the growth in nonfarm demand was often slow. However, the income elasticities assumed in estimating growth in domestic demand for farm products may be too high for some countries and domestic demand for farm products may not have increased as much as indicated. Also, growth in economic demand for agricultural products in urban areas may not have resulted in increased demand at farm levels in some countries because of poor marketing systems.

Economic deficits in production such as those referred to here can be met in two ways: higher prices for agricultural products relative to prices for nonagricultural products, and larger increases in imports than in exports of agricultural products. Higher relative prices for agricultural products would limit increases in per capita consumption of agricultural products and bring effective demand into balance with production. If imports increased more than exports, this would increase supplies of agricultural products available for domestic use and thereby avoid increases in relative prices of agricultural products.

Table 4.--Compound annual growth rates in per capita income, domestic demand for agricultural products, and surplus or deficit in production relative to demand, 45 countries, 1950-68 1/

Country and region	Per capita real income	Income elasticity of demand 2/	Domestic demand			Surplus or deficit in production 4/
			Total 3/	Share due to income growth	Percent 4/	
<u>Latin America</u>						
Costa Rica	1.5	0.5	4.5	14	-0.3	
Dominican Republic	.8	.5	4.0	10	-2.4	
El Salvador	1.9	.5	4.0	25	0	
Guatemala	1.4	.5	4.1	17	.9	
Honduras	1.9	.5	4.2	24	-1.0	
Jamaica	5.1	.4	3.8	53	-1.1	
Mexico	2.7	.4	4.4	25	.7	
Nicaragua	2.2	.5	4.2	26	1.7	
Panama	3.6	.4	4.5	31	-.9	
Argentina	1.3	.3	2.1	19	-.1	
Bolivia	2.5	.7	3.7	40	-.9	
Brazil	2.3	.5	4.2	29	-.4	
Chile	1.6	.4	3.0	20	-.8	
Colombia	1.3	.5	3.9	18	-.7	
Ecuador	1.4	.5	3.8	16	2.2	
Paraguay	.8	.5	3.0	13	-.6	
Peru	2.8	.5	4.1	34	-1.0	
Uruguay	-.7	.4	1.1	-27	-1.2	
Venezuela	2.7	.3	4.5	18	.6	
<u>Europe</u>						
Bulgaria	6.9	.5	4.4	80	-.4	
Greece	5.6	.4	3.0	68	1.6	
Poland	5.4	.4	3.7	60	-.5	
Spain	4.5	.4	2.6	69	.3	
Yugoslavia	6.9	.5	4.6	76	0	
<u>West Asia</u>						
Cyprus	2.6	.3	2.1	38	2.8	
Iran	3.5	.5	4.7	38	-2.0	
Iraq	2.7	.7	4.7	40	-2.7	
Israel	5.4	.3	5.5	29	3.8	
Jordan	6.9	.7	7.6	63	-4.1	
Turkey	2.0	.5	3.7	34	-.3	
<u>Far East</u>						
Burma	2.7	.7	3.8	50	-2.5	
Ceylon	.8	.7	3.0	20	-.1	
India	1.9	.7	3.5	37	-.9	
Indonesia	-.2	.7	2.1	-5	.2	
Japan	8.7	.3	3.6	72	-.3	
Korea	3.4	.7	5.1	45	-1.4	
Malaysia	2.3	.5	4.3	28	-.2	
Pakistan	1.4	.7	3.4	29	-.5	
Philippines	2.2	.7	4.8	32	-1.0	
Taiwan	4.8	.7	6.6	52	-2.2	
Thailand	2.8	.7	5.3	38	-.8	
<u>Africa</u>						
Morocco	-.1	.7	2.1	-33	-1.0	
Sudan	2.0	.7	4.3	33	-.2	
Tunisia	.4	.7	2.4	12	-1.5	
United Arab Republic	4.1	.7	5.4	54	-3.0	

1/ Data for some countries do not cover the entire 1950-68 period. 2/ Coefficients of income elasticity of demand for agricultural products are assumed to vary with per capita income per year as follows: less than \$200--0.7, \$200 to \$400--0.5, \$400 to \$600--0.4, \$600 and over--0.3. 3/ Total increase in demand for agricultural products equals population growth rate plus growth rate in per capita demand. Growth rate in per capita demand is growth rate in per capita real income times coefficients of income elasticity. 4/ Surplus or deficit in production is agricultural production growth rate shown in table 3 less total domestic demand growth rate.

In most countries where production did not increase as much as domestic demand, deficits were met by increasing imports relative to exports. For example, net imports of grain by developing countries increased from 7 million tons a year in 1948-52 to 11 million tons in 1959-61 and 14 million tons in 1964/65 (1). Although agricultural exports of most developing countries rose during 1950-68, many increased their agricultural imports even more. In a few countries, higher prices for farm products relative to prices for nonagricultural products may have helped to bring domestic demand into balance with production.

Failure of agricultural production to increase as much as domestic demand does not necessarily imply poor allocation of resources or failure of agriculture to perform satisfactorily. In some developing countries, it may be economic to emphasize expanding production of non-agricultural products for exports and use the foreign exchange earnings from these exports to import larger quantities of farm products.

In several countries--Guatemala, Mexico, Nicaragua, Ecuador, Greece, Cyprus, and Israel--agricultural production increased substantially more than domestic demand during 1950-68. In general, high rates of growth in production, compared with growth rates in domestic demand, did not cause relative declines in prices of agricultural products because agricultural exports increased relative to imports. Guatemala, Mexico, and Nicaragua greatly increased cotton exports; Ecuador, bananas.

CHANGES IN CROP OUTPUT PER HECTARE

Estimates of growth rates in crop area and crop output per hectare of crop

area were made for 40 of the 54 countries (table 5). Data were not available to make estimates for the other 14 countries. The crop output growth rates differ from agricultural output growth rates shown earlier because only crops for which area data are available were included. Crop output growth rates also differ because agricultural output includes livestock products.

Countries differ widely in their reliance on increasing the area of crops grown or raising output per hectare to expand total crop output. Crop area can be increased in two ways: multiple cropping (growing more than one crop a year on the same land), and adding new land. Output per hectare of crops grown also can be increased in two ways: raising crop yields and planting more crops with a higher value per hectare. Area of crops increased in most countries mainly by adding new land. Growth in multiple cropping was less important. Crop output per hectare of crops grown rose mainly because crop yields increased. However, shifts to include more crops with a high value of output per hectare helped raise crop output per hectare in some countries.

In 11 of the 16 Latin American countries where estimates of increased crop output were made, expansion of crop area was more significant than increased crop output per hectare. Expansion of crop area was especially important in Brazil, Ecuador, Venezuela, and several Central American countries, all of which had large areas of unsettled land suitable for cultivation. But significant increases in crop output per hectare were achieved in some Latin American countries. After 1950, crop output per hectare increased 3 percent or more a year in El Salvador, Guatemala, and Nicaragua.

In six of the 13 Asian countries (excluding Japan) for which estimates were

Table 5.--Compound annual growth rates in crop output, area of crops, and crop output per hectare, 40 countries, selected periods, 1950-68 1/

Country and region	Period	Total output	Crop--		
			Area	Output per hectare	
					Percent
<u>Latin America</u>					
Costa Rica	1950-67	3.7	2.3	1.4	
El Salvador	1950-67	5.4	1.4	4.0	
Guatemala	1950-67	6.7	3.4	3.3	
Jamaica	1950-61	3.4	2.8	.6	
Mexico	1950-65	5.7	3.2	2.5	
Nicaragua	1950-67	7.9	4.4	3.5	
Panama	1950-66	3.1	3.0	.1	
Argentina	1950-67	2.5	1.1	1.4	
Bolivia	1950-67	3.5	2.3	1.2	
Brazil	1950-67	4.3	4.1	.2	
Chile	1950-67	2.2	.7	1.5	
Colombia	1950-68	3.2	1.6	1.6	
Ecuador	1950-67	4.5	2.8	1.7	
Peru	1950-67	3.3	2.1	1.2	
Uruguay	1950-67	- .5	-2.4	1.9	
Venezuela	1950-67	5.4	4.2	1.2	
<u>Europe</u>					
Bulgaria	1950-67	3.0	-1.3	4.3	
Greece	1950-67	4.1	.3	3.8	
Poland	1950-67	3.1	- .4	3.5	
Romania	1950-67	3.5	0	3.5	
Spain	1950-67	1.6	- .1	1.7	
Yugoslavia	1950-66	5.4	.4	5.0	
<u>Asia</u>					
Burma	1954-67	1.6	1.9	-.3	
Ceylon	1951-67	3.2	1.1	2.1	
Cambodia	1954-67	3.9	2.5	1.4	
India	1952-65	2.8	1.3	1.5	
Indonesia	1951-67	1.9	2.2	-.3	
Iraq	1950-67	2.3	2.1	.2	
Japan	1950-67	2.4	- .8	3.2	
Malaysia	1954-67	3.7	1.6	2.1	
Pakistan	1950-67	2.7	1.2	1.5	
Philippines	1950-67	4.1	2.7	1.4	
South Korea	1950-67	4.3	1.5	2.8	
Taiwan	1950-67	3.8	.7	3.1	
Thailand	1950-67	4.5	2.4	2.1	
Turkey	1950-67	2.2	1.5	.7	
<u>Africa</u>					
Libya	1954-67	3.7	5.7	-2.0	
Morocco	1950-67	- .2	- .2	0	
Tunisia	1950-67	-1.9	-1.5	-.4	
United Arab Republic	1950-67	2.9	.6	2.3	

1/ Computed by least squares from data compiled by Foreign Regional Analysis Division, ERS, and Colombia data from (6). The data are for major field crops. They do not include minor crops or crops such as fruits not grown on cultivated land.

made, increases in crop output per hectare were more important than increases in crop area as a source of increased crop output. In densely populated countries like India, Pakistan, and Malaysia, higher crop yields were the major source of growth in crop output. But in countries where additional land was available for cultivation--Iraq, Turkey, Thailand, and the Philippines--expansion in crop area was more important.

The very high growth rates in crop output per hectare in Japan, Taiwan, and the countries of southern and eastern Europe are highly significant, since they indicate there may be large potentials for increasing crop yields in other countries on land already under cultivation. Even in countries where additional land could be brought into cultivation, such land may be so poor in quality that it is more economic to farm more intensively land already under cultivation. Since the area of crops decreased in Japan and in most of the countries of southern and eastern Europe; all of the increase in crop output resulted from more output per hectare. The same is true for the United States.

CHANGES IN AGRICULTURAL OUTPUT PER WORKER

Agricultural output per farmworker is difficult to raise when the number of workers dependent on farming for employment also increases. The number of people dependent on farming for a livelihood rose more than the area in crops in many developing countries, thus diminishing the area in crops per farmworker. Where agricultural land per worker is decreasing, output per unit of land must increase at a high rate if agricultural output per worker is to increase.

Improving agricultural output per worker is a more significant measure of performance than the other measures previously discussed. Agricultural output per worker must increase to provide a basis for increasing real income per worker. More purchased inputs from nonfarm sources (such as fertilizer, pesticides, tools, and equipment) usually are required to increase output per worker. Agricultural "value added" per worker (the net value of agricultural output less the value of purchased nonfarm inputs measured in constant prices) must grow if per capita incomes of the agricultural population are to increase and if agriculture is to be a source of capital for further agricultural production or for transfer to nonagricultural sources.

Statistics on agricultural employment or number of farmworkers are available for only a few countries. However, agricultural population estimates are reasonable indicators of agricultural employment (table 6). In nearly all countries, agricultural production expanded faster than agricultural population.

Agricultural production per farm person has increased since 1950 in all countries for which estimates are presented here. Among countries where agricultural population increased, agricultural output per farm person increased 2 percent or more a year in Mexico, Brazil, Colombia, Venezuela, Cyprus, Israel, South Korea, and Taiwan. In most of these countries, crop area per farm person also increased.

In southern and eastern Europe, as well as Cyprus and Japan, agricultural population has decreased since 1950. In these nations, agricultural output per farm person has increased at compound annual

Table 6.--Compound annual rates of growth in total agricultural production, total agricultural population, agricultural production per farm person, and crop area per farm person, 26 countries, selected periods, 1950-68

Country and region	Total	Total	Agricultural	Crop
	agricultural production, 1950-68 1/	agricultural population, 1950-65 2/	production per farm person	area per farm person
	Percent			
	:			
	:			
<u>Latin America</u>				
Costa Rica	4.2	2.3	1.9	2.1
Guatemala	5.0	3.4	1.6	- .2
Jamaica	2.7	1.3	1.4	1.6
Mexico	5.1	1.7	3.4	1.4
Panama	3.6	2.1	1.5	.4
Argentina	2.0	1.9	.1	- .8
Brazil	3.8	1.3	2.5	3.1
Colombia	3.3	1.3	2.0	.5
Paraguay	2.4	1.8	.6	---
Uruguay	- .1	.8	.9	-2.8
Venezuela	5.1	2.1	3.0	1.8
<u>Europe</u>				
Bulgaria	4.0	-1.4	5.4	- .1
Greece	4.6	- .3	4.9	.4
Poland	3.2	- .2	3.4	- .3
Romania	3.4	- .2	3.6	.5
Spain	2.9	-1.2	4.1	1.1
Yugoslavia	4.6	-1.8	6.5	2.3
<u>Asia and Africa</u>				
Cyprus	4.9	- .8	5.7	---
Iran	2.7	1.2	1.5	---
Israel	9.3	2.2	7.1	---
Turkey	3.4	2.8	.6	- .6
Ceylon	2.9	1.2	1.7	.3
Indonesia	2.3	1.5	.8	.8
Malaysia	4.1	3.1	1.0	-1.5
Thailand	4.5	2.9	1.6	.6
United Arab Rep.	2.4	2.2	.2	-1.2
India	2.6	2.1	.5	- .8
Japan	3.3	-4.5	7.8	3.7
South Korea	3.7	.3	3.4	1.2
Philippines	3.7	2.0	1.7	.7
Taiwan	4.5	2.4	2.1	-1.7

1/ Data are from table 3. They cover a shorter period than 1950-68 in some instances.

2/ Estimates based on data from several sources, including (28) and (49). Data on economically active population in agriculture were used for Ceylon, Costa Rica, Indonesia, Malaysia, Thailand, and United Arab Republic. Crop area is arable land and land under permanent crops as defined in (28).

--- = not available.

rates of 3 percent or more. Output per U.S. farmworker did not increase rapidly until after 1920, when number of farmworkers began to decrease, farming became more mechanized, and crop yields increased rapidly due to use of improved seeds, fertilizers, pesticides, and other nonfarm inputs.

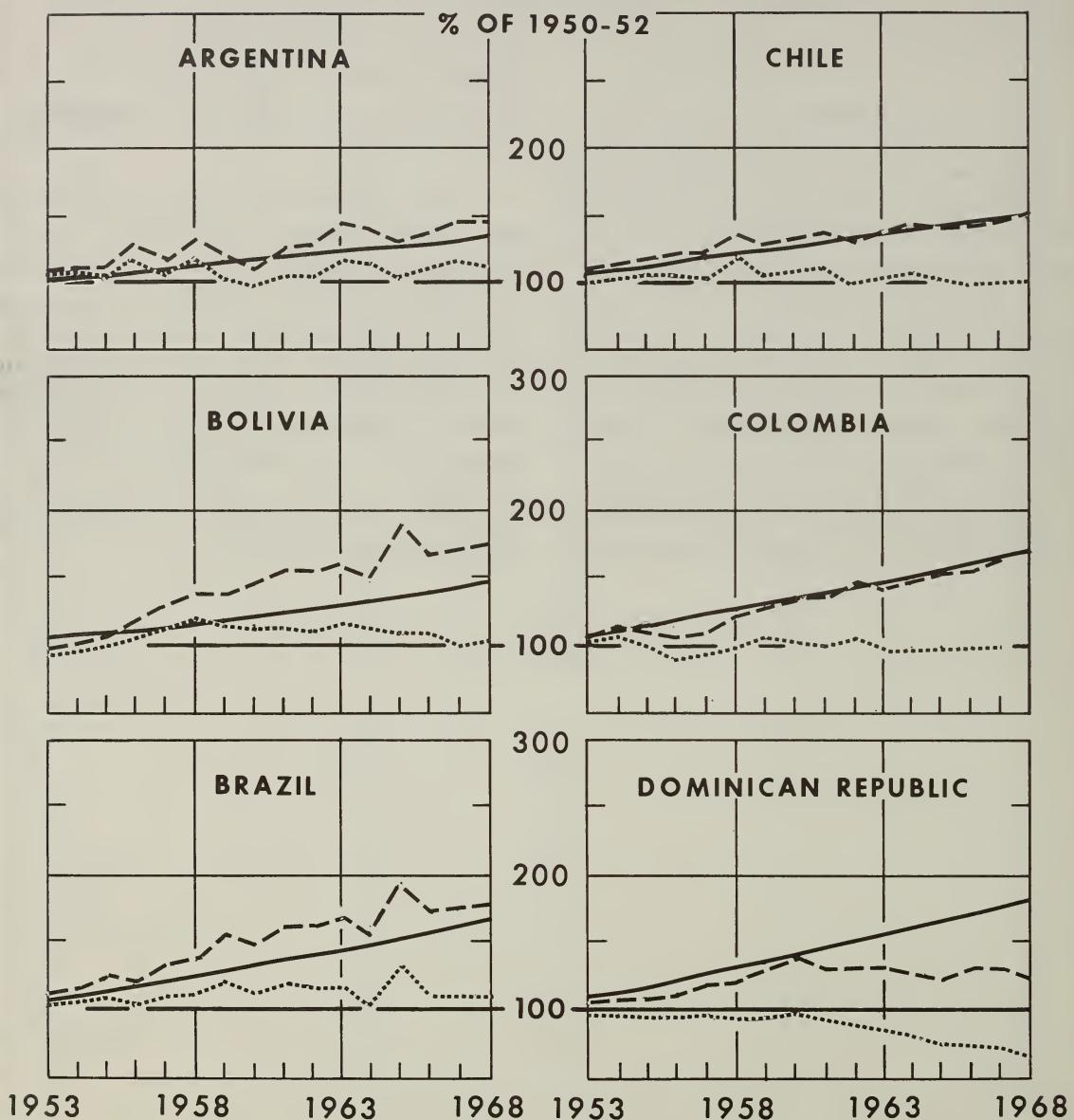
Growth in nonagricultural employment opportunities has been a major factor affecting the number of people dependent upon farming for employment and thereby growth in agricultural output per worker. In most developing countries, the migration of many farmworkers to the cities in search of higher incomes has caused a rapid increase in the urban population. However, nonagricultural employment opportunities have not increased rapidly enough to absorb all the growth in total labor force. There is much unemployment and underemployment of workers in urban and rural areas of most developing nations.

Most developing countries have achieved substantial progress in improving agricultural output per worker. In most countries, the value of inputs purchased from nonfarm sources has increased by relatively small amounts, compared with increases in total value of agricultural output. Consequently, it can be concluded that net agricultural output per farmworker has gone up significantly in most developing countries.

The fact that agricultural output per farm person increased in many countries suggests that a net transfer of capital out of agriculture to other sectors was possible without causing a net reduction in real per capita incomes of farmpeople. However, productivity gains in agriculture have not been large enough in most developing countries to provide a large part of the capital required for economic growth of the nonagricultural sectors.

INDICES OF POPULATION, TOTAL AGRICULTURAL PRODUCTION, AND PRODUCTION PER CAPITA

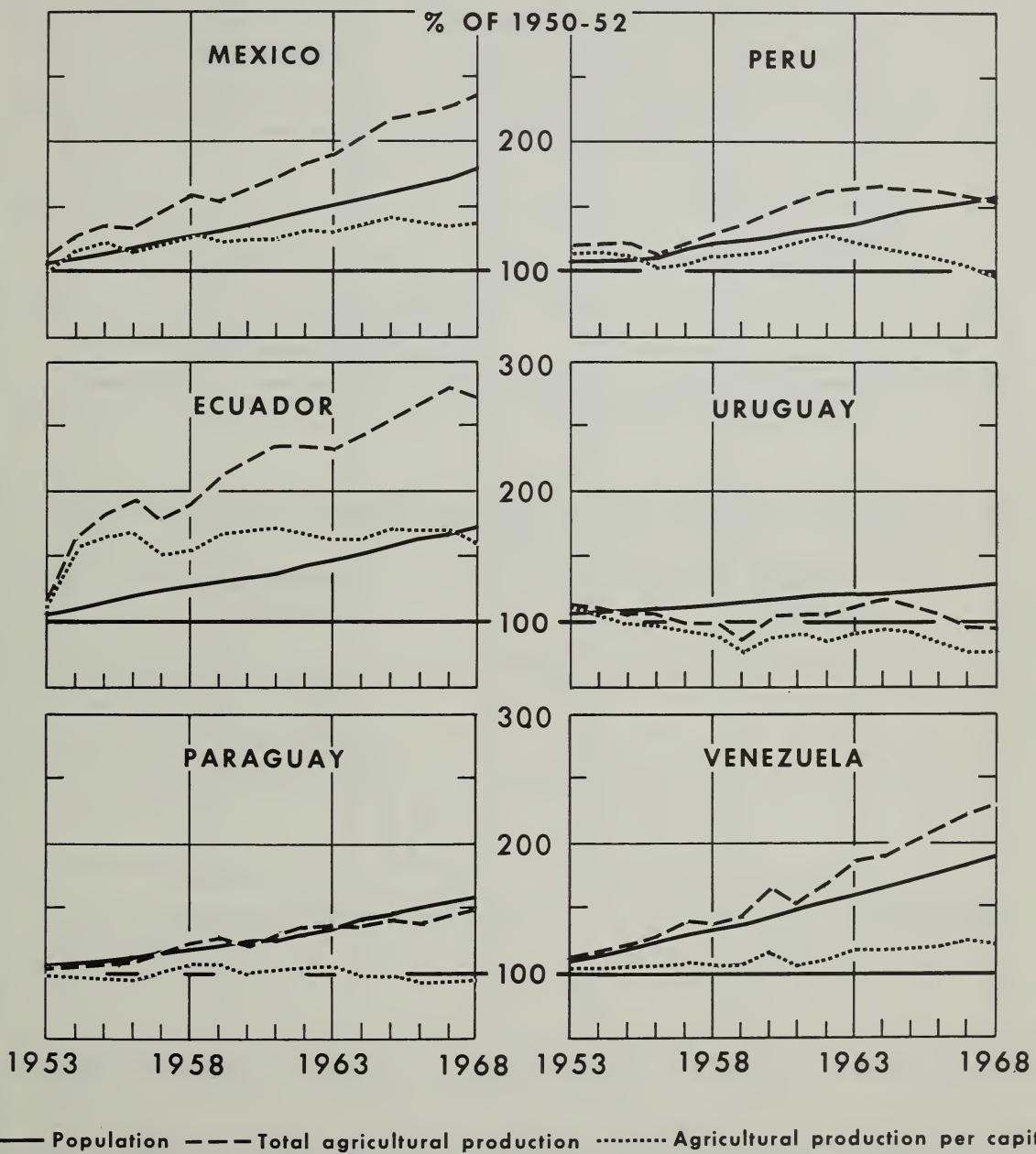
LATIN AMERICA



— Population —— Total agricultural production Agricultural production per capita

INDICES OF POPULATION, TOTAL AGRICULTURAL PRODUCTION, AND PRODUCTION PER CAPITA

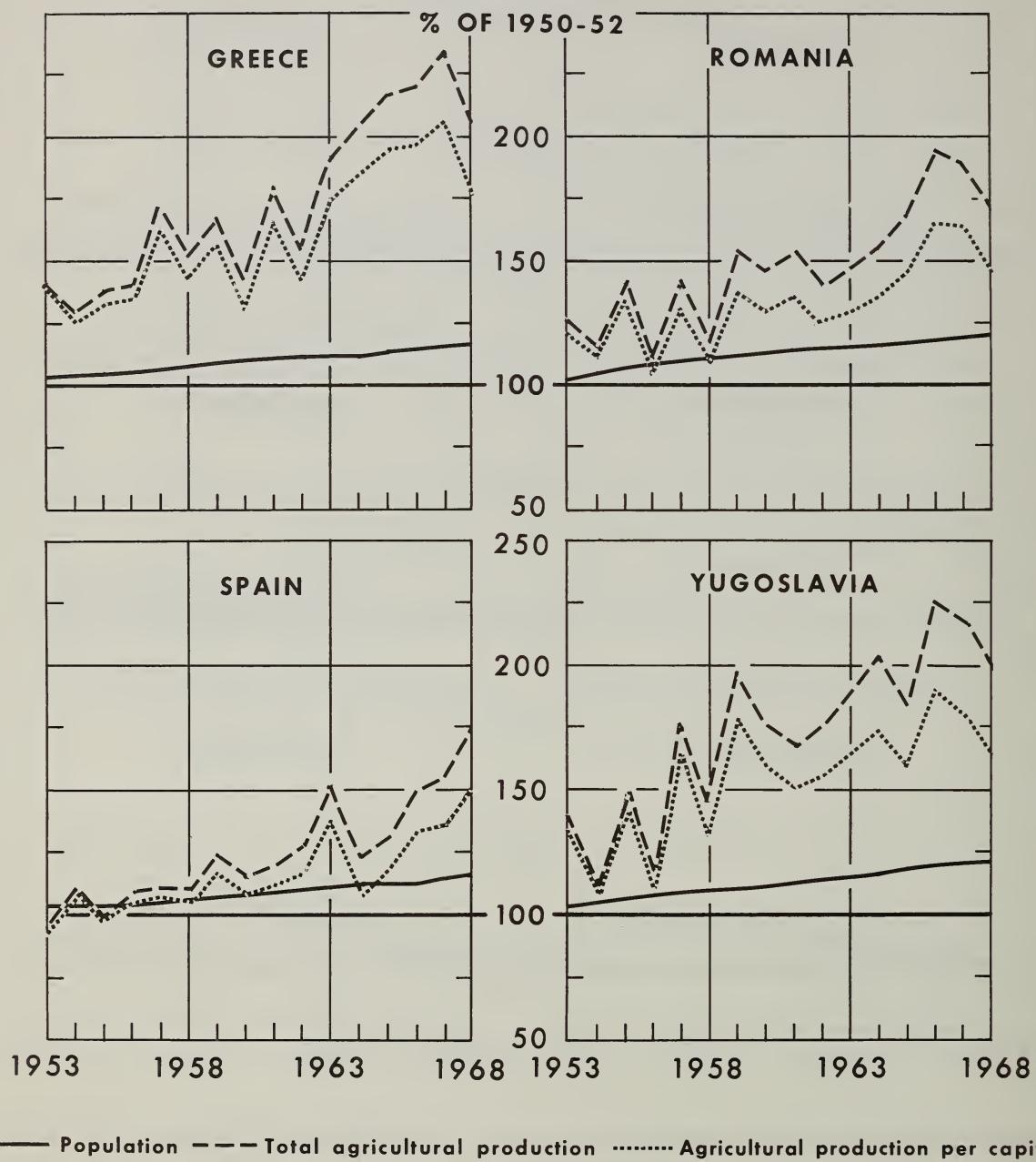
LATIN AMERICA



— Population —— Total agricultural production Agricultural production per capita

INDICES OF POPULATION, TOTAL AGRICULTURAL PRODUCTION, AND PRODUCTION PER CAPITA

EUROPE



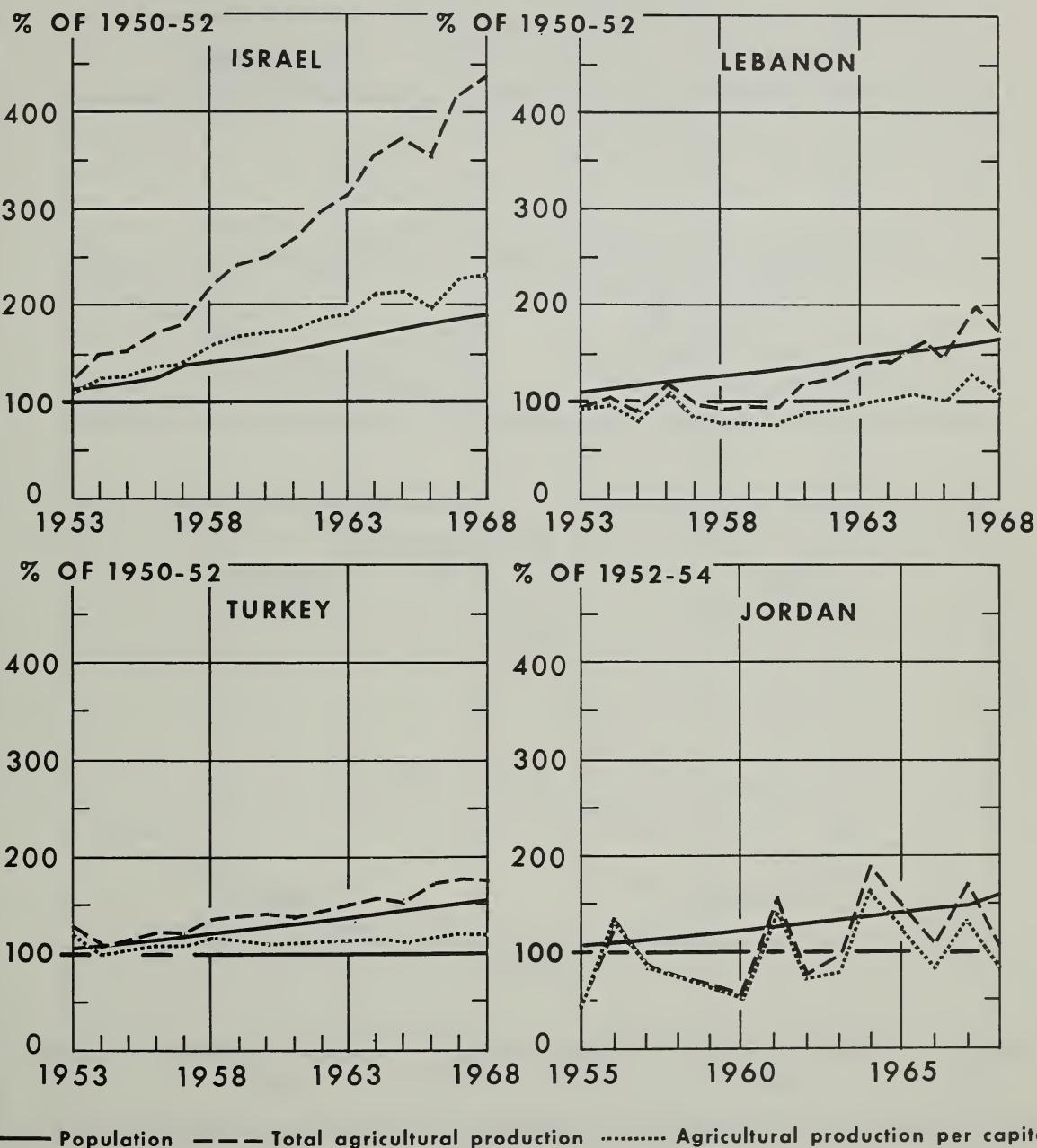
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Figure 8

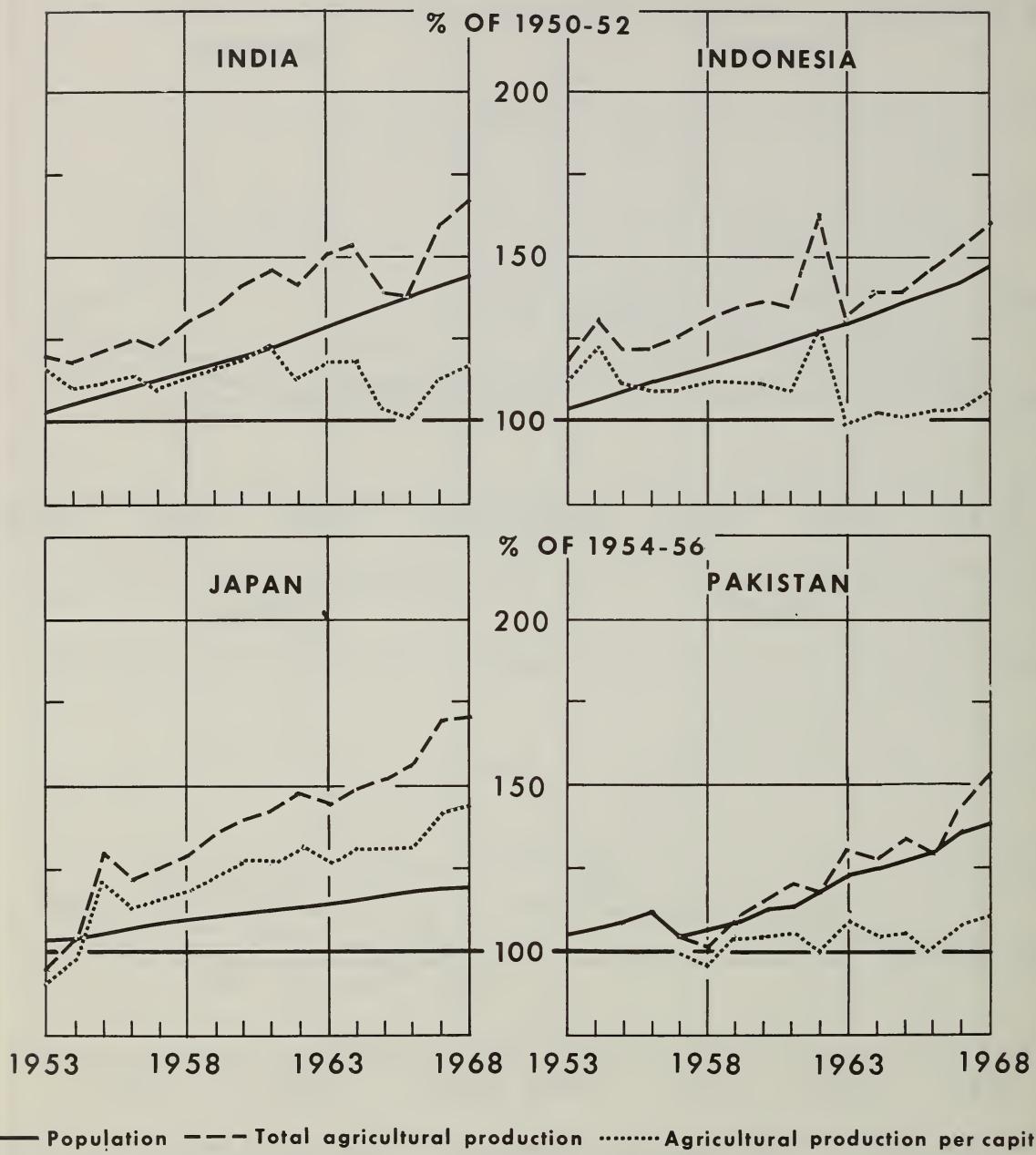
INDICES OF POPULATION, TOTAL AGRICULTURAL PRODUCTION, AND PRODUCTION PER CAPITA

WEST ASIA



INDICES OF POPULATION, TOTAL AGRICULTURAL PRODUCTION, AND PRODUCTION PER CAPITA

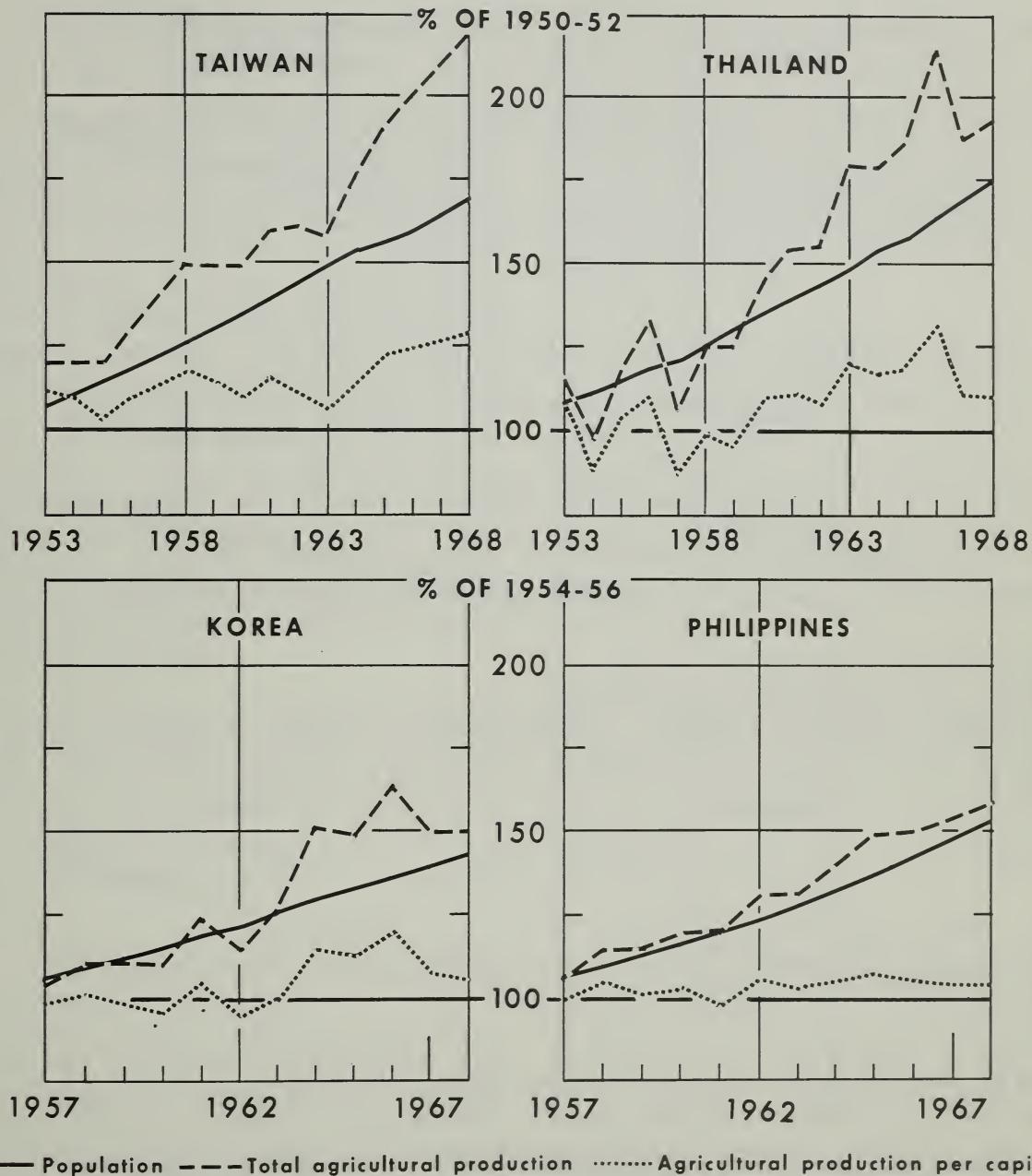
FAR EAST



— Population —— Total agricultural production Agricultural production per capita

INDICES OF POPULATION, TOTAL AGRICULTURAL PRODUCTION, AND PRODUCTION PER CAPITA

FAR EAST



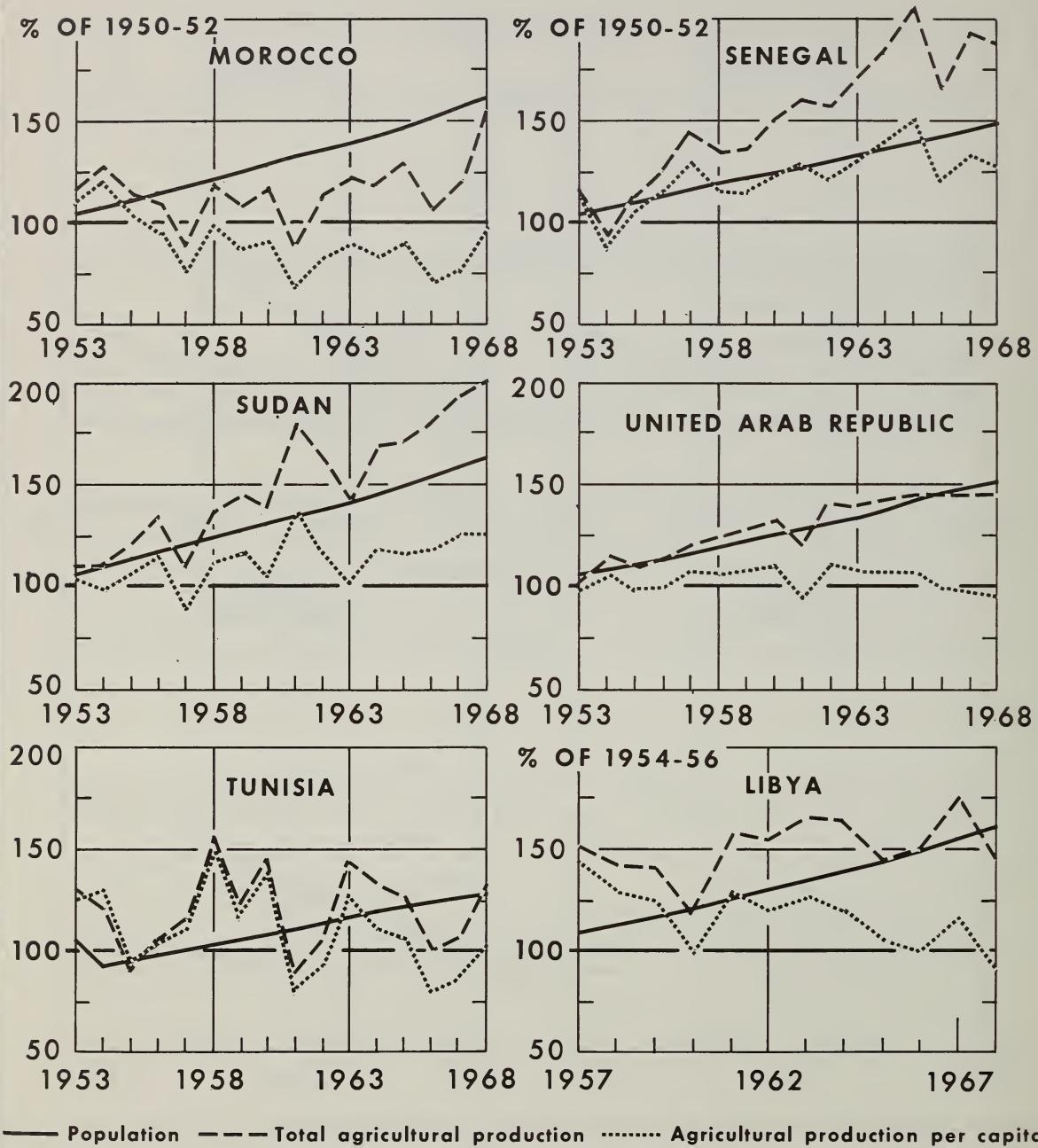
U. S. DEPARTMENT OF AGRICULTURE

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Figure 11

INDICES OF POPULATION, TOTAL AGRICULTURAL PRODUCTION, AND PRODUCTION PER CAPITA

AFRICA



Chapter III. MAJOR FINDINGS FROM SEVEN STUDY COUNTRIES

By R. P. Christensen

MAJOR CHARACTERISTICS OF STUDY COUNTRIES

Of the 54 developing countries reviewed in this study, seven were analyzed in depth: Greece, Taiwan, Mexico, Brazil, Colombia, India, and Nigeria. These countries vary widely in size, stage of economic development, and other characteristics (table 7). India, for example, has twice as many people and nearly twice as much arable land as the other six countries combined. Brazil has about as many people and as large a land area as the rest of Latin America. Wide differences in climate, topography, soils, and kinds of crops grown are to be expected in such large countries. However, there also are important differences among agricultural areas within Mexico, Colombia, Nigeria, Greece, and Taiwan.

Estimates of gross national product (GNP) per capita indicate differences among countries in per capita incomes and in levels of economic development. Per capita incomes varied from over \$700 in Greece to less than \$100 in India and Nigeria in 1965.

Population growth has been rapid in all countries except Greece, where it increased only 0.8 percent a year during 1950-68. Population growth rates have increased since 1950 in all other countries except Taiwan. In Taiwan, the population growth rate declined from 3.7 percent a year in the early 1950's to 2.8 percent in 1968.

Taiwan is by far the most densely populated of the seven countries. It has

only 0.06 hectare (0.15 acre) of arable land per capita, compared with 0.25 hectare in Colombia and larger amounts in other countries. There are large physical potentials for increasing the land area under cultivation in Brazil and Nigeria; some potentials in Colombia, Mexico, and India; but very little potential in Greece or Taiwan.

Agriculture is a major sector in all seven countries. Agriculture's share of total population in 1965 was 70 percent in India and 80 percent in Nigeria, compared with around 50 percent in the other five countries. Agriculture's share of gross domestic product (GDP) varied from only 17 percent in Mexico to 63 percent in Nigeria.

GDP originating in agriculture is agriculture's contribution to national output. Intermediate inputs furnished by nonagricultural sectors for use in farm production are subtracted from the total value of goods and services from farms to obtain a measure of agriculture's contribution to GDP.

In all study countries, per capita GNP averaged much lower in agriculture than in nonagricultural sectors (table 8). In Mexico and Greece, GNP per capita was only about one-fourth as high in agriculture as in other sectors in 1965. In the other countries, GNP per capita averaged less than half as high in agriculture as in other sectors. In contrast, per capita GNP in the non-agricultural sectors averaged two to eight times as high in Greece and Mexico as in the other countries. Per capita

GNP in agriculture also averaged higher in Greece than in the other countries.

Per capita incomes of farmpeople averaged about the same in Brazil, Colombia, and Mexico.

The differences in per capita GNP indicate approximate differences in per capita incomes. In some countries, people classified as agricultural may work off farms part of the time and share in the income from nonagricultural production. Consequently, the estimates may underestimate per capita incomes of the agricultural population to some extent.

Income and productivity levels differ widely within the agricultural sectors of the study countries. Such differences are most marked in Latin America where modern farming methods in some areas yield high labor productivity, but traditional methods followed in other areas result in low labor productivity. In Mexico, for example, gross value of agricultural output per worker averaged 10,222 pesos on large private farms of over 5 hectares, compared with only 651 pesos per worker on small private farms of 5 hectares or less, and 2,318 pesos per worker on ejido farming units averaging 19 arable hectares. In Nigeria, although

Table 7.--Major characteristics of the study countries

Country	: Gross	: Annual	Agriculture's share of--	
	: national	: population	: Gross	: Total
	: product	: growth	: domestic	: population,
	: per capita	: 1950-68	: product,	: 1965
	: 1965	: 1965	: 1965	: 1965
	---	---	---	---
	<u>1966 dollars</u>		<u>Percent</u>	
Greece	712	0.8	23	53
Taiwan	221	3.2	26	47
Mexico	474	3.3	17	52
Colombia	287	3.2	33	47
Brazil	306	3.0	27	52
India	74	2.2	44	70
Nigeria	77	2.1	63	80
	---	---	---	---
	: Share of	: Rice,	: Fertilizer	
	: Arable land	: arable	: yield per	: per hectare of
	: per capita	: land	: hectare,	: arable land
	: :	: irrigated	: 1966	: :
	---	---	---	---
	<u>Hectares</u>		<u>Percent</u>	
Greece	0.44	17	4,940	68
Taiwan	.06	60	3,750	270
Mexico	.50	15	1,960	18
Colombia	.25	4	1,930	30
Brazil	.34	2	1,450	9
India	.31	16	1,280	8
Nigeria	.48	---	1,040	---
	---	---	---	---

Sources: Gross national product estimates were obtained from (2). Population data were provided by the Foreign Regional Analysis Division, ERS. Gross domestic product estimates came from (51), (68), and (85). The remaining data were obtained from (28).

Table 8.--Gross national product per capita, selected study countries, 1965 1/

Country	Gross national product		
	per capita of--		
	Total	Agricultural	Nonagricultural
	popu- lation	popu- lation	popu- lation
	<u>1966 dollars</u>		
Greece	712	310	1,180
Taiwan	221	126	303
Mexico	474	184	707
Colombia	287	185	390
Brazil	306	181	431
India	74	46	140

1/ Gross national product was distributed between agricultural and nonagricultural sectors in the same proportions as gross domestic product, as reported in (85). Gross domestic product originating in agriculture and in nonagricultural sectors was divided by agricultural and nonagricultural population to obtain per capita estimates.

modern methods are employed on a few plantations, a very low level of technology prevails throughout the country.

Cropland is used intensively in Greece and Taiwan, and crop output per hectare is much higher in these countries than in the other study countries. For example, rice yields per hectare are two to three times higher in Greece and Taiwan than in the other countries. Large quantities of fertilizer and other nontraditional inputs are used per hectare in Taiwan and Greece, but only small amounts are employed in the other countries. Irrigated land is important in Taiwan, Greece, Mexico, and India, but not in Colombia, Brazil, or Nigeria.

AGRICULTURAL AND NON- AGRICULTURAL GROWTH

All study countries have achieved substantial economic growth since 1950. Compound annual growth rates in GDP (measured in constant prices) varied from a high of 7.7 percent a year in Taiwan to 3.9 percent in India during 1950-65 (table 9). 3/ Gross domestic product tripled in Taiwan, more than doubled in Mexico, Greece, and Brazil, and nearly doubled in Colombia and India.

Growth rates in GDP originating in agriculture were lower than growth rates originating in nonagricultural sectors in all countries except Brazil. In most countries, growth rates in agricultural production would be expected to be lower than in nonagricultural production, because as per capita incomes rise, demand for nonfarm products and services increases more than demand for farm products.

Growth rates in total, agricultural, and nonagricultural populations differ widely among the study countries. These estimates are approximations because precise data on number of people in each category are not available. In Greece, where total population increased only 0.8 percent a year, per capita gross domestic product increased nearly 5 percent a year. Although population increased 3.3 percent a year in Taiwan, per capita GDP increased 4.4 percent. Mexico also recorded notable development with an annual per capita GDP growth rate of 2.7 percent, despite a population growth rate of 3.3 percent a year. Growth was substantial in Brazil,

3/ Nigeria is not included in statistical tables showing changes since 1950 because time series data are not available.

although it was not sustained after 1965. Economic growth in Colombia and India was slower.

Agricultural population decreased in Greece, where the total population growth rate was very low. In India, agricultural population increased at about the same rate as the nonagricultural population. However, in the other study countries, agricultural population increased less than nonagricultural population. Nonagricultural population increased at very high rates--5 percent or more a year from 1950 to 1965 in Mexico, Brazil, and Colombia.

These differences in population growth rates influence growth rates in per capita GDP originating in agriculture and nonagricultural sectors. In Colombia, large increases in the urban population took place, so that per capita GDP originating in nonagricultural sectors remained nearly constant. In Mexico it increased only 1.3 percent a year.

Natural growth rates are at least as high for the agricultural population as for the nonagricultural population. In Mexico, Colombia, and Brazil, large numbers of farmpeople migrated to

Table 9.--Compound annual growth rates in gross domestic product, population, and per capita gross domestic product for total nonagricultural and agricultural population, selected study countries, 1950-65 1/

Item	Greece	Taiwan <u>2/</u>	Mexico <u>3/</u>	Colombia	Brazil <u>4/</u>	India <u>5/</u>
: - - - - <u>Percent</u> - - - -						
Gross domestic product:						
Total	: 5.8	7.7	6.0	4.6	5.9	3.9
Nonagricultural	: 6.4	8.7	6.4	5.3	6.4	4.7
Agricultural	: 4.0	5.5	4.3	3.2	4.7	2.9
Population:	:					
Total	: .8	3.3	3.3	3.0	2.9	2.1
Nonagricultural	: 2.4	4.2	5.2	5.4	5.0	2.1
Agricultural	: -.2	2.4	1.5	1.3	1.4	2.1
Per capita gross domestic product:	:					
Total	: 4.9	4.4	2.7	1.5	3.0	1.8
Nonagricultural	: 4.0	4.1	1.3	-.1	1.4	2.6
Agricultural	: 4.4	2.9	2.8	2.0	3.3	.8

1/ Compound annual growth rates calculated by least squares. Computations were made using 1966 factor costs: That is, indirect taxes are excluded but subsidies are included. Minor differences may be noted in growth rates shown here and growth rates in other chapters because of different national account definitions (e.g., gross domestic product vs. gross national product) and method of valuation (e.g., market prices vs. factor costs). 2/ 1951-65. 3/ Gross domestic product at market prices. 4/ Calculated from an index of real product. 5/ Net national product growth rates calculated by an end-point method.

Sources: Population growth rates computed from data in (6), (28), (39), (49), (58), (82), (83), and (87). Gross domestic product growth rates computed from (2), (12), (15), (37), (38), (44), and (68).

urban areas, thereby helping to increase average incomes of those who remained on farms. However, a large share of those who moved to urban areas were unemployed or underemployed much of the time, depressing average incomes in urban centers.

Providing productive employment opportunities for increasing numbers of workers was a major problem in all countries. Even Greece had difficulty finding jobs for its slowly growing labor force. The nonagricultural sectors, despite a growth of more than 6 percent a year, could not provide jobs for the annual 1-percent growth in the labor force. Many Greeks migrated to jobs in nearby countries. Labor force on farms did not begin to decline until the early 1960's.

Taiwan made relatively full use of its rapidly growing labor force. Yet the nearly 9-percent annual growth rate in the nonagricultural sectors did not provide full employment. Although many farmpeople migrated to urban centers, labor force in agriculture increased 2.5 percent a year, much more rapidly than in other countries. Labor intensive farm enterprises were introduced. Also, public works projects employed part of the growing labor force.

Mexico had difficulty finding jobs for the rapidly growing labor force, despite a 6.4-percent growth rate in nonagricultural production. Policies were adopted to keep people on farms, but large numbers migrated to urban areas where the rate of unemployment and underemployment of workers was substantial. On small private farms and ejido farm units, underemployment remained high and labor productivity relatively low.

In Colombia, where nonagricultural output increased 5.3 percent a year,

employment problems were more severe than in Mexico. In large cities, 12 to 14 percent of the total labor force has been unemployed in recent years. Colombia has relatively modern farms in some areas and many traditional farms in others. It also has a dual organization in nonagriculture with handicraft and service industries paying very low wages and modern sectors (including manufacturing, public utilities, and parts of transportation) with relatively high wages. Job expansion in modern sectors has been slow in relation to numbers of workers seeking jobs.

In Brazil, much migration has taken place among agricultural regions and also from rural to urban areas. This migration has helped equalize regional differences in labor supply and employment opportunities. But underemployment and unemployment still are chronic problems in the older agricultural regions, especially the northeast.

Because of India's very large population, its employment problems are staggering, compared with those in other study countries. The share of labor force employed in agriculture has remained relatively constant at about 70 percent. About 30 percent of the farm labor force are landless farm laborers. Nonagricultural sectors have not grown rapidly enough to provide many jobs for farmpeople who migrate to towns and cities. Unemployed accounted for 5.1 percent of the total labor force in 1966; but the underemployed (those who had some work but were willing to take up additional work) constituted 10-11 percent of the employed (26).

Nigeria also has a severe rural-urban migration problem. Young people going to the cities in search of jobs often end up with low-paying, part-time employment in the service sectors or in petty trade, or they simply exist

without employment. Extended family systems and the tropical climate greatly facilitate this movement. Government efforts to slow down this migration (such as farm settlement schemes to employ young people leaving rural schools) have not been very successful. A survey in Nigeria in 1961 showed that 13 percent of the labor force in large towns was unemployed (26).

AGRICULTURAL PRODUCTION GROWTH RATES

In the country studies summarized later in this report, attention is focused on growth rates in total agricultural output and factors affecting these growth rates. These growth rates sometimes differ significantly from those described earlier because of differences in the years and products covered and in computational procedures (table 10).

Changes in agricultural productivity are indicated by growth rates in ag-

ricultural production per farm person. Obviously it is easier to increase agricultural output per farm person in Greece, where farm population decreased, than in the other countries where it grew 1.3 percent or more a year.

Factors affecting growth rates in agricultural output and productivity may be considered in seven categories:

1. Growth in use of the traditional inputs of labor, land, and capital goods produced on farms (such as draft animals and certain tools and equipment).
2. Technological advances (such as improved crop varieties and associated production and cultural practices, including diffusion of knowledge about these advances among farmers).
3. Supplies of capital inputs from nonfarm sources (such as fertilizer, pesticides, tools, and equipment).

Table 10.--Compound annual growth rates in total agricultural production, selected study countries and selected periods

Country	Growth rates, 1950-68 1/			Country studies 2/	
	Agricultural production	Agricultural population	Production per farm person	Agricultural production	Period
Percent					
Greece	4.6	-0.3	4.9	4.9	1947-49 to 1965-67
Taiwan	4.5	2.4	2.1	4.4	1950-67
Mexico	5.1	1.7	3.4	4.6	1940-65
Colombia	3.3	1.3	1.9	3.3	1950-67
Brazil	3.8	1.3	2.5	4.5	1947-65
India	2.6	2.1	.5	3.2	1949/50 to 1964/65

1/ These growth rates are from tables 3 and 6. 2/ These are growth rates described in the country summary chapters which follow. They differ from growth rates for 1950-68 described earlier because of differences in years and commodities covered and in computational procedures.

4. Improvement of land and water resources (including land clearing, leveling, drainage, irrigation, and flood control facilities).

5. Growth in domestic and export markets for agricultural products.

6. Institutional arrangements affecting land tenure, farm credit, marketing, transportation, and infrastructure facilities to improve education, health, and other services for rural people.

7. External assistance and investments.

TRADITIONAL AGRICULTURE

Increased use of traditional inputs of land, labor, and capital goods produced on farms was an important source of growth in agricultural production in most countries. Use of labor on farms, for example, increased in all countries except Greece. Land area in crops increased in all countries except Greece and Taiwan.

In parts of Brazil, Mexico, Colombia, India, and Nigeria, agricultural production was expanded simply by using traditional methods on additional land. In Nigeria and Brazil, land resources were so plentiful that it was possible to bring new land into cultivation and attain crop yields about as high as those on land previously cultivated.

Thus, extending traditional farming methods to new land did not raise output per acre or per worker, but it did provide economic opportunities for the increased rural population and a means of expanding total agricultural production. Some investment in infrastructure (such

as for new roads, education, and public health programs, especially in lowland tropical areas) was required, however.

TECHNOLOGICAL ADVANCES

In Greece and Taiwan and in large sections of the other study countries, much of the expansion in agricultural production was achieved by introducing new farming methods to increase crop output per hectare. Crop output per hectare increased over 3 percent a year in Greece and Taiwan, and 2.5 percent in Mexico (table 11). Nearly all of the increase in crop output in Greece and Taiwan, and about half of the increase in Mexico, Colombia, and India were from increased output per hectare. In Brazil, expansion of area in crops accounted for about 95 percent of the growth in crop output. In Nigeria, some of the increased output of export crops was due to improved technology, but area increases were more important. Yields of subsistence food crops in Nigeria have changed little.

These increases in crop area include effects of adding new land and multiple cropping. In Taiwan, for example, cultivated land area has not increased since 1950; all the growth in crop output has resulted from more multiple cropping and higher crop yields.

Compound annual growth rates in yields of important crops provide a more direct indication of progress in improved technology (table 12). Crop yields increased significantly in all countries except Brazil, where a few crops showed gains. Improved varieties sometimes made possible increases in yields, but a combination of nontraditional inputs was usually required. Improved varieties, coupled with increased use of fertilizer,

Table 11.--Compound annual growth rates in major crop output, area of crops, and crop output per hectare, and shares of increases in total crop output from increases in crop area and crop output per hectare, selected study countries, 1950-68 1/

Country	Crop--			Shares of increases in total		
	Output	Area	Output per hectare	: crop output from increases		in--
				Crop area	Crop output per hectare	
----- Percent -----						
Greece	4.1	0.3	3.8	7	93	
Taiwan	3.8	.7	3.1	18	82	
Mexico	5.7	3.2	2.5	56	44	
Colombia	3.2	1.6	1.6	50	50	
Brazil	4.3	4.1	.2	95	5	
India	2.8	1.3	1.5	46	54	

1/ Data on growth rates and periods are from table 5. The percentage share estimates computed from growth rates in area of crops and crop output per hectare.

irrigation improvements, and better cultural practices, contributed to higher yields of cotton in Colombia and wheat and cotton in Mexico and Greece.

All study countries have agricultural research programs, but they vary in coverage and duration. In Greece and Taiwan, development of improved crop varieties and pest control methods has contributed to improved crop yields over the last 30 years. In Brazil, Colombia,

India, and Nigeria, some research has been in progress for many years to improve production of export crops such as coffee, tea, cocoa, jute, oil palm, and sugarcane. But relatively little research was done in most of these countries on domestic food crops until the last 10-15 years. In India, an expanded agricultural research program over the last decade now is yielding useful results and providing a technological basis for increasing crop yields.

Table 12.--Compound annual growth rates in yields per hectare of selected crops, selected study countries, 1950-65 1/

Country	Rice	Wheat	Corn	Cotton
	----- Percent -----			
Greece	1.7	3.0	4.5	3.0
Taiwan	3.0	4.6	3.9	.3
Mexico	2.0	7.4	2.9	5.5
Colombia	.8	1.7	.2	5.6
Brazil	.5	-1.2	.3	1.4
India	2.3	1.7	3.4	1.0

1/ Computed from (28).

Highly productive new varieties of wheat developed by the International Wheat and Maize Improvement Center (CIMMYT) in Mexico, and rice developed at the International Rice Research Institute (IRRI) in the Philippines, enabled India and other countries in southeast Asia to go immediately to large-scale cultivation on farms without much locally adaptive research. These are outstanding examples of transferring technology from one country to another. However, these new varieties of wheat and rice were developed in tropical areas. In India in 1968/69, approximately 25 percent of the wheat acreage and 7 percent of the rice acreage were planted with new varieties, most of which were imported (22).

New varieties are highly responsive to increased applications of fertilizer in irrigated areas and have potentials for doubling yields in irrigated areas when complementary "packages" of improved practices are followed (91). It should be noted that "packages" of improved technology (involving pest and disease control, fertilizer use, and other practices in addition to new seeds) have been transferred from abroad in some instances. This was true, for example, of cotton in Mexico; cotton, rice, and sugarcane in Colombia; and poultry and hogs in most countries. The development of improved breeds of cattle adapted for tropical areas has been a problem in most countries. On the whole, it has been easier to transfer improved technology involving chemicals, such as fertilizer and pesticides, than biological materials.

The increases in agricultural production per farmworker referred to earlier have involved the introduction of laborsaving methods and some mechanization of farming operations. For example, increased use of tractors and other farm machines has been important in Greece and parts of Mexico, Brazil, Colombia,

and India. In these countries, machinery has helped to expand the area under cultivation and usually has not been substituted for labor. Except in Greece and some areas of Brazil, the principal alternative to the tractor for land cultivation is not a team of horses or mules pulling a steel moldboard plow but a hand hoe or wooden plow drawn by bullocks, cows, or water buffalo. Sometimes these crude methods are supplemented with a steel point or running edge that breaks the crust of the ground for a few inches but does not turn it over. In Nigeria, neither tractor nor animal power is used to a significant degree; almost all power is human labor aided by primitive hand tools.

Much of the expansion in crop production in sections of the study countries, such as the irrigation districts in Mexico, the fertile valleys of Colombia, and parts of India and Brazil, involved the use of tractors and machines, however. In Taiwan, agricultural output expansion was achieved with limited mechanization for field cultivation, but more extensive use of machines for threshing grains and other purposes. Gains in farm production per worker were achieved in irrigated areas of some countries by increased multiple cropping and more intensive use of land.

Countries vary widely in the extent to which agricultural education and extension services have been established. In general, extension services have been developed to about the same degree as agricultural research. Taiwan, for example, has a highly developed system of vocational agricultural training for rural youths and also a well-developed extension service operating through farmers' associations. In Greece and Mexico, agricultural banks provide educational services as well as credit for farmers. In Brazil, Colombia, and Nigeria, extension services are developed

principally for commercialized crops such as coffee, cocoa, cotton, oil palm, and rubber by organizations concerned with promoting these crops.

Usually, farmers will readily adopt new methods (such as planting improved crop varieties) when they find changes will be profitable and credit is available to finance the use of needed inputs. But they are slow to adopt new farming methods requiring more knowledge or yielding relatively low economic returns.

PURCHASED CAPITAL INPUTS

Capital inputs account for a larger share of all inputs used in farm production in the less developed countries than is generally realized. For example, capital inputs account for about one-third of the value of all inputs used in farm production in the Punjab of India, Taiwan, Colombia, and Brazil, compared with about 40 percent in Japan and 67 percent in the United

States (table 13). Increases in agricultural production per hectare and per worker have required large increases in purchased nontraditional inputs such as fertilizer, pesticides, tools, equipment, and other materials from nonfarm sources. In the Punjab of India, where crop output per acre increased 4.7 percent a year and crop output per worker increased 4.3 percent a year from 1950/51 to 1964/65, purchased nonfarm inputs increased 10.7 percent a year. 4/ Use of farm-produced capital inputs also increased, as did land and labor inputs. However, the value of the additional purchased inputs was small, compared with the value of additional production. Net value of crop output (after subtracting value of purchased inputs from the value of crop output measured in constant prices) increased 4.1 percent a year per farmworker. Opportunities to increase productivity by using better crop varieties, applying more fertilizer and pesticides, and improving

4/ Sen, B. Capital Input in Punjab Agriculture: 1950/51 to 1964/65 (unpublished report).

Table 13.--Estimates of the percentage distribution of inputs used in farm production, selected countries and selected periods

Input	Punjab of India <u>1/</u>	Taiwan, 1961-65 <u>2/</u>	Columbia <u>3/</u>	Brazil, 1962-63 <u>4/</u>	Japan, 1955-59 <u>5/</u>	United States, 1967
Land	44	41	36	35	17	15
Labor	21	27	31	29	42	18
Capital, total	35	32	33	36	41	67
Farm produced	27	11	21	10	---	7
Purchased nonfarm	8	22	12	26	---	60
Total	100	100	100	100	100	100

1/ B. Sen, Capital Input in Punjab Agriculture: 1950/51 to 1964/65, (unpublished report). 2/ (13). 3/ L. Jay Atkinson, Agricultural Productivity in Columbia (unpublished report). Economic Research Service, U.S. Dept. Agr. 4/ Louis F. Herrmann, Changes in Agricultural Production in Brazil, 1947-65 (unpublished report). Economic Research Service, U.S. Dept. Agr. 5/ (92).

irrigation facilities have been much greater in the Punjab than in most other areas of India and in most other countries.

Fertilizer consumption estimates indicate the relative importance of purchased nonfarm inputs. In Greece and Taiwan where crop yields are relatively high, large amounts of fertilizer are used per hectare and consumption rates have gone up greatly since 1950 (table 14). In Nigeria and Brazil, where land area under cultivation can be extended, fertilizer consumption rates are relatively low. Fertilizer inputs have also been low in Mexico and India, but are increasing rapidly.

Table 14.--Fertilizer consumption in plant nutrients per hectare of arable land, study countries, selected periods

Country	: 1950-52 : : Annual growth	
	: 1964-66 : rates, 1950-52	average : : to 1964-66
	: - Kilograms - - Percent -	
Greece	16.0	60.0
Taiwan	109.0	224.0
Mexico	1.4	13.0
Colombia	5.8	20.0
Brazil	2.9	7.9
India	.4	4.2
Nigeria	.1	.1

Sources: (27), and (28).

In Brazil, Colombia, Mexico, and India, use of nontraditional inputs has increased most rapidly in areas with good transportation and communication facilities near large growing cities. Fertilizer use has risen greatly in irrigated areas throughout India in the last 2 years, following the introduction of responsive new varieties of wheat and rice.

In Colombia, new farm operators--mainly growing imported, improved

varieties of cotton, rice, and sugarcane--were more likely to expand their use of nontraditional inputs. They were sometimes renters, and often from urban areas. They used tractors on relatively fertile land and applied pesticides liberally. They obtained moderately high yields with little fertilizer on cotton and heavier use on rice and sugarcane.

Facilities for distributing fertilizer, pesticides, tools, equipment, and other purchased inputs are most highly developed in the most productive land areas. In Mexico, for example, they are relatively well developed in irrigated areas but not in the dryland areas.

The extent to which lack of credit or credit on reasonable terms limits the use of purchased inputs by farmers varies widely among the study countries and among areas within these countries. Greece established an agricultural bank to finance and distribute fertilizer and other capital inputs to farmers and thus encourage greater use of purchased inputs to increase crop yields. Colombia followed the same pattern, but the scale of activities was more limited as specific recommendations and supplies of nontraditional inputs were often lacking. Taiwan made large amounts of production credit available through farmer associations or cooperatives. In Mexico and Brazil, operators of large commercial farms obtained production credit mainly from commercial banks. Lack of credit at reasonable terms has limited use of purchased inputs and growth in agricultural output in some countries.

LAND AND WATER IMPROVEMENTS

The development of improved drainage, irrigation, and flood control facilities greatly influenced expansion

of agricultural output in Greece, Taiwan, Mexico, and India. In these countries, most of the growth in crop yields and much of the expansion in farm production took place on irrigated land. Irrigated land also is becoming significant in Colombia. But most farming areas in Colombia, as in Brazil, have good rainfall.

Brazil, Colombia, and Nigeria have serious soil erosion and soil depletion problems in some areas. Land suitable for cultivation is plentiful in these countries and new land has been brought into cultivation to replace old land that has deteriorated in fertility. However, parts of eastern Nigeria, northeastern Brazil, and the Andean regions of Colombia are densely populated and movement of people to frontier areas is necessary to make more effective use of land resources.

Significant increases in land area under irrigation have been made in Greece, Mexico, Colombia, and Brazil (table 15). But growth rates in area of land irrigated do not fully reflect the extent of irrigation improvements. In Greece, Taiwan, and India, there has been much improvement of drainage, irrigation, and flood control facilities on land that has been irrigated

Table 15.--Share of arable land irrigated and growth in area of irrigated land since 1950, selected study countries

Country	Share of arable land irrigated	Compound annual growth rate in irrigated land	
		Percent	Year
Greece	15.0 (1965)	5.9	(1951-66)
Taiwan	57.9 (1966)	.5	(1950-66)
Mexico	14.8 (1960)	5.3	(1950-64)
Colombia	4.5 (1960)	12.0	(1950-60)
Brazil	1.5 (1960)	12.6	(1950-60)
India	16.1 (1965)	1.9	(1950-65)

Source: (28).

for many years. Expansion in tubewells and minor irrigation facilities has been very important in India.

Governmental agencies or organizations have been mainly responsible for planning and carrying out irrigation and related improvements. Governments have invested large amounts to make more effective use of land and water resources. Irrigation, drainage, and flood control were viewed as infrastructure investments necessary for expanding agricultural production. The fees farmers pay for irrigation water usually cover only a part of the costs.

Large numbers of rural people were employed on irrigation, drainage, and flood control projects. Usually, not much mechanized equipment was used. Labor of rural people was an important source of capital formation for increasing future agricultural output.

FARM PRICES AND MARKETS

Economic growth of nonagricultural sectors results in growth in demand for farm products and was a major factor affecting agricultural output growth rates in the study countries. Prices of farm products need to be high enough to provide economic incentives for farmers to apply improved technology and purchase needed inputs if agricultural production is to increase at a high rate. However, maintaining prices at high enough levels to increase volume of farm output depends on growth in demand or markets.

Population and income growth in urban areas has been essential in providing larger commercial markets for farm products in the study countries. GDP growth rates of nonagricultural sectors during 1950-65 indicate at least

approximately how total incomes have increased in urban areas. Urban markets for farm products are very important in Greece, Taiwan, Mexico, Brazil, and Colombia, where about half of the total population live in urban areas. However, in India and Nigeria, where 70 to 80 percent of the total population depend upon farming for a livelihood, farmpeople still provide the main market for basic food crops.

In most countries, agricultural production would have increased at higher rates if commercial markets had grown more rapidly. In Nigeria, for example, farmers could have produced more of the basic food crops for sale in urban areas if market outlets had been larger. In Colombia, industrial growth was uneven and lack of expanding markets for farm products limited growth in agricultural production in some years.

Export markets for agricultural products also have affected agricultural output growth rates. With the exception of India in 1965, agricultural exports were a large share of agricultural GNP

and also total GNP in all study countries (table 16). The value of agricultural exports exceeded that of agricultural imports in all countries except Greece and India. The study countries rely heavily on agricultural exports to earn foreign exchange. Agricultural exports accounted for over 80 percent of all exports from Brazil and over 70 percent of those from Greece and Colombia, compared with 56 percent in Taiwan and 41 percent in India in 1965.

Agricultural exports of Mexico, Greece, and Taiwan increased 3 percent or more a year from 1955 to 1967 (table 17). Agricultural exports also increased in Brazil, but declined in Colombia and India. Agricultural imports of Taiwan and India increased over 10 percent a year. Taiwan was the only country where total exports grew more rapidly than total imports. In Colombia and Brazil, total exports and imports decreased.

Greece and Mexico imported a large share of their food grain requirements in the early 1950's, but by the late 1960's Greece was about self-sufficient

Table 16.--Agricultural exports and imports as percentages of agricultural GNP, total GNP, and total exports and imports, selected study countries, 1965 1/

1/ Computed from data in (2) and (86). Agricultural exports include agricultural, forestry, and fishery products.

Table 17.--Compound annual rates of change in agricultural and total exports and imports, selected study countries, 1955-67 1/

Country	Agricultural--		Total--	
	Exports	Imports	Exports	Imports
	----- Percent -----			
Greece	4.4	4.4	5.5	7.6
Taiwan	7.6	11.4	14.7	10.9
Mexico	3.0	1.3	2.1	4.0
Colombia	-3.3	-4.7	-2.3	-2.1
Brazil	1.4	1.4	-.3	-1.3
India	-1.4	12.2	1.9	4.3
:	:	:	:	:

1/ Data sources are indicated in footnote 1 of table 16. Exports and imports are in constant prices. Compound annual rates of change were computed by least squares. Slope coefficients were insignificant at 5-percent level for growth rate of total exports of Brazil and agricultural imports of Mexico.

and Mexico was a net exporter of wheat. They also increased their exports of fruit and vegetables. Mexico's output of major export crops increased 7 percent a year from 1940 to 1965, much more than domestically consumed crops. Taiwan exported over half its rice and sugar production in the 1930's, but a much smaller share has been exported in recent years as domestic markets increased with population and income growth. However, Taiwan's exports of fruits and vegetables have increased since 1950.

Brazil's agricultural exports increased slowly, notably corn. On the other hand, Colombia was not able to increase agricultural exports rapidly enough to compensate for the decline in coffee prices after the mid-1950's. India had to resort to large food grain imports, especially during the severe drought years.

Nigerian export crops--cocoa, oil palm, and peanuts--were the main sources of exchange to finance imports of capital goods required for economic development. Prices paid to farmers for these crops, through Government marketing boards, have been below those received in foreign markets after allowing for marketing costs. Low prices to farmers may have limited growth in production of these crops, but they provided funds to finance infrastructure improvements and other developmental activities, many of which were not directly related to agriculture.

Prices of agricultural products have increased about as much as prices of other commodities and services in the study countries since 1950. In India, Government policies and programs were established to stabilize food prices or to prevent them from rising to high levels. Food grain production probably would have increased more during the 1950-65 period if prices had been permitted to rise to higher levels.

Farm product prices for basic crops differ widely among the study countries. Greece, Mexico, Colombia, and Brazil have maintained domestic prices for wheat and rice considerably above those in the world market. India also has maintained high prices for wheat, and rice prices now are above those in world markets. Corn prices in Brazil have been about the same as those in other exporting countries.

Fertilizer prices have been high relative to farm prices of rice in Colombia, Brazil, and India, but low in Greece, Taiwan, and Mexico (table 18). Relative to the farm price of wheat, fertilizer prices have been low in Greece, but fairly high in the other countries. It should be noted that these are national averages and the ratios may be much lower in regions within countries where

large amounts of fertilizer are used. Also, prices for nitrogen fertilizer have decreased relative to crop prices in the last 3 years, making increased use of nitrogen profitable in most countries.

Marketing facilities also have affected agricultural output growth rates. Facilities for transporting, storing, and processing farm products are highly developed in Greece and Taiwan and in parts of the other study countries. However, large parts of Nigeria, India, Brazil, Colombia, and Mexico have poor transportation facilities and limited access to commercial markets. Agriculture in these areas has remained largely traditional.

INSTITUTIONAL ARRANGEMENTS

Governments have played a major role in facilitating agricultural develop-

ment. In Mexico and Taiwan, irrigation and related land improvement programs planned and carried out by governmental agencies provided the chief basis for achieving rapid growth in agricultural output. In most countries, it has been easier to determine what needs to be done than it has been to effectively implement development plans. Country studies indicate that high growth rates in agricultural production can be achieved with widely different institutional arrangements affecting land tenure, farm credit, marketing, educational, and other services to rural people.

Mexico, Taiwan, and Greece carried out major land reform programs. In Greece, land reform was necessitated by the urgent need to assimilate large numbers of Greeks returning as a result of the exchange of populations with Turkey, beginning in 1923. In 1952, a constitutional

Table 18.--Kilograms of rice and wheat required to purchase a kilogram of fertilizer at prices prevailing in 1966/67, selected study countries 1/

Commodity and country	Kilograms of commodity required to purchase a kilogram of fertilizer				<u>Average 2/</u>	
	Nitrogen (N)	Phosphate (P_2O_5)	Potash (K_2O)	:----- Kilograms -----:		
Rice (paddy):						
Greece	1.7	1.2	0.9	1.4		
Taiwan	3.3	1.7	.9	2.4		
Mexico	1.6	1.1	.6	1.5		
Colombia	4.1	4.2	4.5	4.3		
Brazil	8.4	3.9	2.4	4.5		
India	4.2	4.5	1.5	4.0		
Wheat:						
Greece	2.1	1.5	1.1	1.8		
Taiwan	4.5	2.5	1.3	3.5		
Mexico	3.4	2.2	1.2	3.1		
Colombia	3.4	3.5	3.8	3.6		
Brazil	5.3	2.4	1.5	2.9		
India	4.1	3.4	1.1	3.6		

1/ Data from (28) and from country studies summarized in chapters V-XI. 2/ Weighted average based on proportions used in each country.

limit on size of land holdings of 30 hectares was imposed, and land made available was used for farm enlargement. More recently, consolidation of fragmented holdings has been a major Government project.

Land reform in Mexico involved Government expropriation of land from large, privately owned estates and the transfer of this land to landless farm-workers under the ejidal system of land tenure. Ejidatarios, farmers who received land, could not sell or mortgage their land. After 1940, ejidatarios constituted about one-half of all farm operators. In 1960, they occupied about 40 percent of all cropland and accounted for about 40 percent of total crop production. Production performance of ejidos has been good. During 1940-62, crop production increased at a compound annual rate of 4.5 percent on ejidal land, compared with 5.6 percent on private land. Crop yields increased 2.4 percent a year on ejidal land and 2.9 percent a year on private land. The more rapid growth of crop production per hectare on private land than on ejidal land may have resulted from more extensive irrigation and use of fertilizer. Ejidatarios market a large share of the crops they produce. In 1960, export crops accounted for 27 percent of the total value of all crops produced on ejidos, compared with 30 percent on private land. Ejidos are less highly mechanized and use much more labor per hectare than the large private farms. Consequently, crop output per worker is much lower on ejidos than on the large private farms. Land reform in Mexico provided improved economic opportunities for many landless workers and helped create a stable political environment which contributed to national economic growth. The fact that ejidatarios could not mortgage their land to obtain credit and could not sell their land retarded

mechanization and expansion in sizes of farm units. This restriction also may have retarded migration to urban areas, although many people have migrated from ejidos to cities.

In Taiwan, over half of all cropland and two-thirds of all irrigated land was operated by tenants before land reform was initiated. Land reform involved: rent reduction and other improvements for tenants, beginning in 1949; sale of public land to tenants in 1952; and Government purchase of privately owned tenanted land and its resale to tenants, starting in 1953. The Government purchased all privately owned holdings in excess of 3 hectares for paddy (irrigated) land and 6 hectares for dryland, and resold it to tenants on terms that involved annual payments no larger than the former rentals. Land ownership encouraged farmers to make land improvements and use land more intensively, and thereby contributed to increased output per hectare. As farm population increased, farm units decreased in size from an average of over 2 hectares in the late 1940's to about 1 hectare in 1968. Migration to urban areas in search of jobs probably would have been much greater had it not been for land reform. Land reform created improved economic opportunities for many rural people. However, it should be noted that rapid progress in increasing total agricultural production and crop yields also took place before land reform in the 1920's and 1930's.

In India, some States have initiated land reform programs involving reduction in rents and other improvements in tenure conditions, but these programs have not been large enough to greatly influence total agricultural production.

In Brazil and Colombia, governmental agencies have carried out some

settlement programs on new land, but they have not been extensive enough to have much effect on total production. In both countries, many farmpeople moved to frontier areas and brought new land under cultivation. A large share of the most fertile land in these countries is operated in large units with hired labor. The concentration of fertile productive land in relatively large operating units probably sped growth in total agricultural production. Brazil, for example, has achieved a very high growth rate in total agricultural output. Income distribution among farmpeople probably would be more uniform if landownership were more evenly divided, despite the possibility of transitional problems until the new owners become capable farm managers. Additional farm credit, marketing, and other local supporting services would be required.

In Nigeria, land generally was not owned individually, but was controlled by community and tribal groups. Although there was much disparity in access to land between and within tribal groups, only a minute portion of the land was in large estates controlled by private individuals or companies. The communal control of land appears to have inhibited development and modernization of agriculture, although significant expansion in production of export crops and basic food crops has been achieved.

Farm credit facilities vary widely among the study countries. They are well developed in Greece and Taiwan. Commercial banks provide most of the production credit used by operators of large farms in Mexico and Colombia. Brazil has a wide range of credit services, but the supply of credit has been restricted.

In Taiwan, farmers' associations provide credit, marketing, and other services performed in large part by

landlords before land reform was carried out. Similar institutional arrangements to provide supporting services for small farmers are needed in other countries.

The study countries vary widely in education for farmpeople. Literacy levels are highest in Greece and Taiwan and lowest in India and Nigeria. For example, 73 percent of the rural people over 15 years of age were literate in Greece, compared with only 22 percent in India in 1960. Much progress has been made in extending educational opportunities in rural areas, but lack of education limits the ability of rural youths to learn new improved farming practices and to acquire skills needed for nonfarm employment.

Agricultural colleges, universities, and vocational schools have contributed greatly to growth in agricultural output and productivity in the study countries during the last two decades. But these institutions can be expected to have an even more important role in the future by supplying the large numbers of trained people required for research, extension, and public service in agriculture.

EXTERNAL ASSISTANCE AND INVESTMENTS

Foreign economic aid and technical assistance have contributed to economic growth in all study countries. Less than 20 percent of all economic aid has been devoted to improvement of agricultural production and marketing. However, economic aid for industrial development and infrastructure facilities has contributed indirectly to economic development of agriculture.

India and Brazil were the largest recipients of external economic aid (bilateral and multilateral) during 1952-67.

Table 19.--Net economic aid from bilateral and multilateral sources received by study countries, 1952-67

Country	Total 1/	Annual	Percentage of gross national product	Percentage of value of total imports	Percentage of gross capital formation
		Million dollars	Dollars	Percent	---
Greece	892	6.76	1.3	7.8	---
Taiwan	1,403	7.94	4.6	24.2	26.7
Mexico	808	1.41	.3	4.2	---
Colombia	789	3.22	1.2	9.2	6.2
Brazil	2,298	2.07	.7	10.3	8.1
India	7,418	1.01	1.4	19.4	---
Nigeria	470	.75	---	---	---

1/ Compiled from (67).

(table 19). However, Greece and Taiwan ranked highest on a per capita basis, with Taiwan receiving nearly \$8 a year per capita and Greece nearly \$7. Per capita economic aid in Colombia and Brazil averaged over \$3 and \$2 a year, respectively, for the period, compared with about \$1 for India and less than \$1 for Nigeria. Although less than 5 percent of GNP in the study countries, economic aid was significant, compared with gross capital formation or value of total imports. About 70 percent of U.S. economic aid to Taiwan and a large share of that to Greece was for defense support.

Economic assistance included large shipments of agricultural commodities under food aid programs, as well as capital goods and materials urgently needed for industrial development. During the 1952-67 period, the study countries received the following percentages of total economic assistance as food aid:

	Percent
India	55
Taiwan . .	43
Greece. . .	35
Brazil . . .	29
Colombia .	18
Mexico . .	7
Nigeria . .	2

According to a study by Barlow and Libbin (7), food aid contributed significantly to economic growth in the developing countries. Recipient countries would have used more of their scarce foreign exchange to finance food imports and less for capital goods required for industrial development if food aid had not been available.

U.S. economic aid was discontinued to Taiwan in 1965 and to Greece in 1966, as these countries increased their exports and foreign exchange earnings. However,

some food aid programs to Taiwan under Public Law 480 have been continued. Economic aid was a major factor contributing to Taiwan's rapid economic growth. According to a study of the 1951-65 period by Jacoby (52), p. 152), "Aid more than doubled the annual rate of growth of Taiwan's GNP, quadrupled the annual growth of per capita GNP, and cut thirty years from the time needed to attain 1964 living standards."

Much of the economic assistance received by study countries was concerned with building up agricultural research

and educational institutions; only a very small share was for technical aid. The economic effects of these investments in improving agricultural output and productivity have not yet been fully realized. Their benefits will continue far into the future.

Private investments from abroad have supplied substantial amounts of capital for economic growth in the study countries, especially in Mexico, Brazil, and Taiwan. In Mexico, a large part of these investments was for agricultural development.

Chapter IV. PROBLEMS AND POLICIES IN THE 1970'S

By R. P. Christensen

RAPID POPULATION GROWTH

Many of the economic problems of developing countries result from high population growth. Population growth rates in these countries now are twice as high as those ever experienced in developed nations, except during periods of large immigration. Improved health and disease control in developing nations has markedly increased life expectancy; falling death rates and continued high birth rates have raised population growth rates from less than 1 percent a year in the early 1900's to 2.6 percent a year in 1968.

Increased production per worker requires more capital inputs per worker. Generally, this means capital formation must increase at a greater rate than population and the labor force are increasing. However, when population is increasing rapidly, per capita incomes are usually low; hence, little money is available for capital formation.

Among the countries considered in this report, rapid productivity and per capita income gains occurred mainly in countries with low population growth--Japan and countries in southern and eastern Europe. Taiwan and Israel also achieved large productivity and per capita income gains, but they received large amounts of economic aid and capital investments from abroad.

Coale and Hoover estimate that India's gross national product would increase more if population growth were

reduced (14). They reason that high population growth retards capital formation, hence economic growth.

Reduction in population growth rates would make it much easier to achieve rising per capita incomes in the developing countries. Therefore, efforts to curtail population growth should receive high priority in countries desiring a rapid increase in per capita incomes. However, it should be recognized that population growth in most countries will probably remain high for the next decade. Birth rates may decline as family planning programs expand and become more effective, but death rates also will continue to fall as health and sanitation facilities are improved. Consequently, population growth in the developing countries may be expected to continue at or above the current rate of 2.6 percent a year for the next decade.

PRODUCTIVITY AND EMPLOYMENT PROBLEMS

Prospects for continued high population growth raise four important questions:

How can agricultural output be increased fast enough to meet spiraling needs?

How can output per farmworker be raised at the same time that number of workers dependent upon farming for a livelihood increases?

How can increasing amounts of capital be supplied to raise output per farmworker and per hectare?

How can crop output per hectare be increased twice as fast in the next decade as in the 1950's and 1960's?

Future needs for agricultural products will depend upon per capita income growth as well as population growth. As per capita incomes rise, people will spend a large share--40 to 60 percent--of the additional income for more and better food and other agricultural products. Consequently, if population increases 2.6 percent a year and per capita incomes increase 3 to 4 percent a year, supplies of agricultural products must increase 4 to 5 percent a year to keep pace with growth in demand. The composition of agricultural production will need to change to include more animal products, fruits, and vegetables--the kinds of food people want in larger quantities when their incomes rise.

If agriculture is to contribute to growth of per capita income, agricultural output per farmworker must increase. In most developing countries, it will be necessary to find ways to raise farm output and income per worker while the total number of farmworkers increases. Even if population growth rates decline in the future, the people who will be in the labor force 15 years from now already have been born.

Employment opportunities in non-agricultural sectors cannot be expected to absorb all the additional workers resulting from population growth. In Latin America, for example, total labor force is expected to increase 3.1 percent a year from 1965 to 1980, compared with 2.6 percent a year from 1950 to 1965 (8). If nonagricultural employment increases 4 percent a year, about the maximum that can be expected from 1965 to 1980, the number of workers dependent upon farming for employment will increase 2.3 percent a year.

Because agriculture accounts for a large share of total employment, and the number of people seeking employment will grow rapidly, people dependent upon farming for a livelihood will continue to increase in most developing countries for at least the next decade.

FAO projects agricultural population to increase 1.7 percent a year in the developing countries, with nonagricultural population rising 4 percent a year, and total population growing 2.6 percent a year from 1962 to 1985 (table 20). The labor force will grow even more rapidly because a larger share of the total population will be older. If these changes occur, agriculture's share of total population will decrease from 67 percent in 1962 to 55 percent in 1985. 5/

To increase agricultural output per worker, it will be necessary to increase agricultural output per hectare at high

Table 20.--Population of developing countries, 1962 and projected 1985

	Population: 1962:	Projected: 1985	Increase:	Annual growth rate
	: Million	: - <u>persons</u> -	- - <u>Percent</u> - -	
Agricultural	: 935	1,388	49	1.7
Nonagricultural	: 460	1,127	145	4.0
Total	: 1,395	2,515	80	2.6

Source: (31).

5/ It should be noted that FAO's Indicative World Plan (IWP) classifies countries in three groups: Zone A--Developed Market Economies, Zone B--Centrally Planned Economies, and Zone C--Developing Countries. Data in table 20 and following tables based on FAO's IWP are for Zone C, which includes 64 developing countries.

rates in most countries. It may be possible to increase greatly the area under cultivation in some Latin American and African countries, but large increases will not be possible in most of Asia and much of Latin America and Africa. FAO projections indicate that it should be possible to achieve an increase of 17 percent in arable area and 35 percent in harvested area from 1962 to 1985 (table 21). Harvested area would increase more than arable area by increased cropping intensity.

Table 21.--Arable and harvested area in developing countries, 1962 and projected 1985

Item	:	Arable	Harvested
	:	area	area
	:	<u>Million hectares</u>	
1962	:	563	385
1985 (projected)	:	660	520
	:	- - <u>Percent</u> - -	
Increase	:	17	35
Annual growth rate:		.7	1.3
	:		

Source: (31).

Agricultural population in the developing countries is expected to rise more rapidly than arable or harvested area. Arable area per agricultural person may decrease about 1 percent a year, and harvested area 0.4 percent a year (table 22).

The growth rate of 4 percent a year in total agricultural production assumed here may seem modest, but it is much higher than the 2.8-percent increase a year achieved by developing nations since 1950. Agricultural production will need to increase 3.3 percent a year per arable hectare and 2.7 percent a year per harvested hectare if total agricultural production is to grow 4 percent a year.

Earlier, it was pointed out that grain yields per hectare increased 1.5 percent a year in developing countries during 1954-67 (table 1), while crop output per hectare increased less than 3 percent a year in most countries (table 5).

To achieve a growth rate of 4 percent in total agricultural production, crop yields in the developing countries must increase almost twice as much each year for the next 10 years as they did during the 1950's or the 1960's.

A growth rate of 2.3 percent a year in production per agricultural person is lower than the rates achieved in several countries (including Brazil, Mexico, Venezuela, Greece, Israel, and South Korea) during the 1950-68 period (table 6). However, it is higher than the rates achieved in Colombia, Taiwan, and many other countries. And, it is much higher than the overall growth rate of less than 1 percent a year in agricultural output per farm person achieved by the developing countries during the 1954-68 period.

If agricultural output per farm person grew 2.3 percent a year, the increase in real per capita income for farmpeople would still not be very large. Expansion of agricultural output per farm person will require increased expenditures for capital inputs from nonfarm sources. Net real value of agricultural production per farm person (after deducting the value of purchased nonfarm capital inputs from the total value of agricultural production, both measured in constant prices) would increase less than 2.3 percent a year.

Prospects do not appear hopeful for improving real incomes of farmpeople in developing countries, while relying on agriculture as a source of capital to expand nonagricultural output, unless

Table 22.--Compound annual growth rates in land area, agricultural population, and agricultural productivity, developing countries, 1962-85 1/

Item	Compound annual growth rate
Area and population increases:	<u>Percent</u>
1. Arable area	0.7
2. Harvested area	1.3
3. Agricultural population	1.7
4. Arable area per agricultural person (1-3)	-1.0
5. Harvested area per agricultural person (2-3)	- .4
Needed increases:	
6. Total agricultural production	4.0
7. Production per arable hectare (6-1)	3.3
8. Production per harvested hectare (6-2)	2.7
9. Production per agricultural person (6-3)	2.3

1/ Data are from tables 20 and 21 except the agricultural production growth rate which is assumed.

agricultural output per farm person increases faster than 2.3 percent a year.

Part of the gains in real income resulting from increased productivity per farm person might be transferred out of agriculture by taxation, lower relative prices for farm products, or other ways. But agriculture cannot supply much capital for nonagricultural sectors without reducing incomes of farmpeople. Farmers' incomes already are much lower than the average for the rest of the population. With even a modest growth rate in real income per farm person of 2.3 percent a year, per capita incomes of the farm population would double in about 30 years.

WHAT NEEDS TO BE DONE

Recommendations for increasing agricultural productivity vary among countries, depending upon resources

available, growth in markets for farm products, and opportunities for employment in nonagricultural sectors. However, major requirements are similar for all countries.

Research and Education

Extensive research is needed to develop more productive and better adapted varieties of crops and breeds of livestock and related technology. Growth rates in agricultural output of 3.3 percent per arable hectare and 2.7 percent per harvested hectare referred to above are predicated on knowledge of plant diseases and pest control, as well as new crop varieties that are highly responsive to increased fertilizer applications. New varieties of wheat and rice recently introduced into Asian countries, which greatly increase crop yields on irrigated land with the application of large amounts of fertilizer and improved cultural practices, illustrate what is

possible. But relatively little has been done thus far to develop better crop varieties for dryland areas or areas dependent upon rainfall. These areas account for about 85 percent of the agricultural land in the developing countries.

Because of the need for more effective use of limited water resources, much research on developing efficient irrigation, drainage, and flood control systems will be essential. Similarly, engineering research is required to develop machines, tools, and equipment to increase output and labor productivity on small farms.

Agricultural education programs must be greatly expanded to provide large numbers of trained staff for agricultural experiment stations, extension services, public agencies, and agriculturally related industries. FAO estimates that minimum needs for trained agricultural personnel will total 133,000 for senior workers and 637,000 for field workers in 1985 (31, vol. III, p. 55). If these numbers are achieved, professional and technical workers in agriculture would equal 0.4 percent of the agricultural labor force in the developing countries in 1985. But this percentage would still be very low, compared with the current share of 5 percent in the developed or industrial countries.

Basic education needs to be improved to raise the literacy levels of rural people. This would not only speed the adoption of better farming practices, but would better equip those who migrate from rural areas to compete for higher paying jobs.

Development of Land and Water Resources

Land and water resources must be used more intensively by bringing

additional land under cultivation, expanding and improving irrigated areas, and increasing the area under multiple cropping. The growth of 1.3 percent a year in harvested area referred to above will require irrigated arable area to expand 1.7 percent a year--nearly 50 percent--from 1962 to 1985, and irrigated harvested area to grow 2.9 percent a year--nearly 100 percent--during the same period (31, vol. III, p. 23). These large increases will require extensive investments of labor and materials. A high level of technical competence will be necessary to plan and effectively carry out projects to expand the irrigated area and to improve existing irrigated land.

Purchased Inputs

The use of purchased inputs--fertilizer, pesticides, farm machinery and equipment, and other materials--must rise much more rapidly than in the past if agricultural output per arable hectare is to increase 3.3 percent a year. Use of fertilizer and crop protection materials will need to grow about 11 percent a year from 1962 to 1985 (table 23). Total expenditures for major capital inputs must rise 5.1 percent a year.

The Tennessee Valley Authority (TVA) estimates that fertilizer use (plant nutrients) should expand from 3.5 million tons (about 4 kilograms per arable hectare) in 1962-63 to 36 million tons (about 44 kilograms per arable hectare) in 1980 (57). This would bring fertilizer use per hectare in the developing countries in 1980 to the average amount applied per arable hectare in the developed countries in 1962-63.

Credit at reasonable terms must be made available for farmers to finance the use of purchased inputs. FAO estimates that a fivefold increase in the

Table 23.--Purchased capital inputs in developing countries,
1962 and projected 1985

Input	1962	Projected	1962-85		
			1985	Change	Annual growth rate
			Million dollars	Percent	
:					
Seed	1,673	2,474	2,474	48	1.7
Feed	3,029	6,994	6,994	131	3.7
Fertilizers	671	8,362	8,362	1,146	11.6
Crop protection	180	2,077	2,077	1,054	11.2
Mechanization	797	2,610	2,610	227	5.3
Irrigation	1,495	2,434	2,434	63	2.1
Total	7,845	24,951	24,951	218	5.1
:					

Source: (31, table 5, p. 72).

volume of annual operational credit disbursed in 1962 will be required in 1985 (31, vol. III, p. 53).

Farm Mechanization

Substituting mechanical power and machines for labor generally will not be economic unless crop output per hectare is greatly increased by more timely farming operations or more intensive use of land through additional multiple cropping. However, in some countries with large areas of new land suitable for cultivation, mechanization may facilitate expansion of the cultivated area and lead to increased employment and output. In the densely populated countries, small machines, tools, and equipment need to be improved to raise labor productivity on small farms. For example, better machines and facilities for threshing and drying grains are urgently needed in areas where multiple cropping can be increased. More mechanical equipment for expanding irrigated area and making more effective use of water on existing irrigated land also will be economic in many developing countries.

Farm Prices and Markets

Marketing arrangements, transportation of farm products to urban areas, and distribution of production requisites and consumption goods in rural areas need to be improved in most countries. Transportation, storage, and other marketing services are so poor for the basic food crops in some countries, farmers have little economic incentive to increase output, even though urban markets are expanding.

Better marketing arrangements and facilities to increase the efficiency of marketing systems would help reflect increased domestic and export demands for farm products at the farm level. If prices of food at consumer levels are held down, economic incentives of farmers to increase agricultural output and productivity may be destroyed.

Price uncertainty for farm products needs to be reduced by price support, storage, and related programs. But most developing countries cannot afford to subsidize agricultural production or to

maintain farm product prices at very high levels. In some instances, it may be economic to subsidize the use of productive new crop varieties, fertilizer, and other inputs to stimulate farmers to adopt farming methods that increase crop yields. However, once widespread use is made of more productive farming methods, subsidies should no longer be necessary.

Productive Use of Abundant Labor

With rural labor forces continuing to expand, it is extremely important that productive work be found for these people--on farms, in farm-related industries and services, or in improvement of rural resources that will result in future expansion of farm production or otherwise add to national output. Expansion of economic activity concerned with processing and marketing farm products or supplying farmers with production requisites and consumption goods should provide many opportunities for productive employment of rural people.

Because private enterprise is not likely to provide full employment for increasing numbers of rural workers, there is need for public work programs also. Efficient use of public funds necessitates giving priority to projects that will result in capital formation by using direct labor with a minimum of new equipment and to activities that will increase agricultural output. Such land improvement measures as terracing, land leveling, drainage, minor irrigation, and reclamation of wastelands meet these requirements. Access roads and needed storage facilities are examples of capital improvements utilizing direct labor and local materials.

Since most developing countries have large pools of unemployed people in towns

and cities, expansion in urban employment should absorb these pools before drawing on rural areas. But over the long term, the rural sector should have an important role in economic development by supplying workers for industry.

Investment Requirements

Large capital investments will be needed for land improvement and development, farm equipment and machinery, livestock and buildings. FAO estimates that cumulative investments for these purposes from 1962 to 1985 (1962 prices) total \$112 billion, compared with a total gross value of crop and livestock, fishery, and forestry output of \$55 billion in 1962 and \$122 billion in 1985 (31, vol. III, p. 72). The investments would average about 7 percent of gross value of output a year. Estimates of investment requirements, cumulative from 1962 to 1985, for identified items are as follows:

	<u>Million dollars</u>
Land improvement and development	47,100
Equipment, machines, etc.	39,064
Livestock inventory and buildings	18,229
Fisheries: vessels, etc.	4,329
Forestry and logging ...	<u>3,743</u>
 Total, identified invest- ments	 112,465

A large share of these investment requirements can be produced with rural labor and materials, but some will need to be purchased from nonfarm sources. In addition, large investments in marketing,

transportation, and infrastructure facilities to improve education, health, and recreation for rural people will be necessary.

WHO WILL BENEFIT?

Wide differences in productivity and income levels of farmpeople now prevail among different agricultural areas within developing countries. Some farms are modern and commercialized, providing fairly high incomes to their operators. Many are traditional and primitive, affording meager returns. These differences may become even greater in the future as some farmers benefit more than others from technological advances and expanding markets (89). For example, introduction of new productive varieties of wheat and rice in India and Pakistan has enabled many farmers in irrigated areas to increase production and incomes. But farmers in dryland areas have not benefited.

On the other hand, many small farmers within irrigated areas lack either the knowledge to take advantage of the more productive varieties or the credit to finance the use of new seeds, fertilizer, and other production requisites.

It is also true that large increases in output of some commodities, such as grains, in some areas may lower prices and farmers' incomes elsewhere, unless market demands increase greatly.

But the fact that technological advances may benefit some farmpeople more than others does not mean that these advances should not take place. Indeed, there would be no easy way to assure the equitable distribution of their benefits.

Economic growth in developing countries depends heavily upon increased

productivity in agriculture. There will be those who do not benefit, or who may even find that technological advances in agriculture reduce their incomes. But efforts need to be made to help disadvantaged small farmers by supplying them with improved knowledge, production requisites, credit, and other requirements for sharing in the benefits of new technology, or by finding more productive employment for them.

Landownership may affect the distribution of economic gains from technological advances. In some countries where much land is operated by tenants, landowners may capture the economic benefits of improved technology by displacing tenants and using mechanized methods and relatively little hired labor. For example, the new high-yielding varieties of wheat in Pakistan may make it profitable for landowners to operate their land with tractors and other machinery, even though it may not result in more production than would be achieved by tenants operating the land with animal power (54). The substitution of machinery for farmworkers who do not have productive employment opportunities elsewhere and which does not increase total agricultural production will reduce agriculture's net contribution to national output and income.

Policies affecting farm sizes may affect how rapidly gains in agricultural productivity are achieved, as well as income distribution in agriculture. As farm population grows in countries where the land area under cultivation cannot be greatly increased, farms must increase in number (and thereby decrease in average size) or the number of workers per farm will have to rise. The latter alternative may be the most efficient way to increase total agricultural production, especially in the short run. But such an increase may cause income distribution among farmpeople to become more un-

even. And over the long term, establishing more farms with fewer workers per farm may be an efficient way to increase agriculture output (especially if local supporting agricultural services were provided) and at the same time bring about more equal income distribution.

The large numbers of farmworkers who have migrated to towns and cities have created large pools of unemployed and underemployed people in the urban centers of most developing countries. Such persons have compounded not only their economic problems, but their social, welfare, and political problems as well. Unless employment opportunities in towns and cities increase rapidly, most farmpeople may find, that for the next decade or so, their best economic opportunity may be to continue in agriculture.

ECONOMIC GROWTH IN THE REST OF THE ECONOMY

Progress in improving productivity and incomes in agriculture will depend heavily upon economic growth in the rest of the economy. Rapid economic growth of nonagricultural sectors is needed to provide larger market outlets for farm products, nonfarm employment opportunities, and capital inputs to apply improved agricultural technology.

Most technological advances that increase output per hectare and per farmworker also increase total agricultural production. Earlier, it was pointed out that domestic demand for farm products in developing countries can be expected to increase 4 percent a year if real per capita incomes increase 3 to 4 percent a year. However, if per capita incomes in nonagricultural sectors do not keep pace, a 4-percent annual increase in agricultural

production would depress farm product prices and make it uneconomic for farmers to increase productivity. On the other hand, if the demand for farm products increases more than 4 percent a year as the result of acceleration of economic growth in nonagricultural sectors, it would become highly profitable for farmers to purchase the additional capital inputs required to increase output per farmworker and per hectare.

Large numbers of farmpeople will need to move to urban areas if agricultural population is to increase only 1.7 percent a year during the 1970's as projected above (table 20). If employment opportunities in nonagricultural sectors increase rapidly and nonagricultural population increases more than 4 percent a year as the result of a large net migration of farmpeople to urban areas, farm population will increase less than 1.7 percent a year, and it will be easier to increase output and income per farm person. Policies and programs that cause nonagricultural employment opportunities to increase more than 4 percent a year will help accelerate per capita income and output growth in agriculture.

Gains in output per hectare and per farmworker will be influenced by the efficiency with which nonagricultural sectors supply farmers with capital inputs and carry out farm marketing services. Lower costs for fertilizer, pesticides, tools, equipment, and other materials supplied from nonfarm sources will help make their use profitable. Lower marketing costs will help increase farm prices and expand markets for farm products.

Monetary and fiscal policies have important effects on national economic growth. Policies that accelerate economic growth rates will help raise per capita incomes of rural as well as urban people.

FOREIGN TRADE, AID, AND INVESTMENTS

To achieve high economic growth rates, most developing countries will need large imports of capital goods and other materials as well as managerial and technical skills. There are three ways of financing larger imports: increased export earnings; increased private foreign investments; and increased foreign economic aid.

The total volume of exports from developing countries increased 4.3 percent a year from 1953 to 1968 (30). But the volume of agricultural exports from these countries has changed little since 1955 (table 24). Petroleum, minerals, and other primary or manufactured products accounted for all of the growth in exports. The share of agricultural products in total exports declined from about 60 percent in the early 1950's to less than 40 percent in 1968.

Agricultural imports of developing countries nearly doubled from 1955 to 1967. However, agricultural exports still are an important source of foreign

exchange earnings. In 1968, agricultural exports exceeded agricultural imports by \$7.4 billion in these countries (table 25).

Developing countries' prospects for increasing export earnings by expanding agricultural exports are not promising. First, the demand for agricultural products is growing slowly in developed countries, and second, the agricultural output of developed countries is growing rapidly, compared with population.

Total agricultural output of developed countries increased 2.8 percent a year during the 1950's and 1960's, compared with a population growth rate of 1.2 percent a year. Consequently, agricultural imports increased slower than agricultural exports. From 1955 to 1967, the total volume of agricultural exports rose nearly 70 percent, while agricultural imports increased only 40 percent. Rapid technological advance in agriculture has been a major reason for rapid growth in agricultural output in industrial countries. The low-income countries will need to achieve large productivity gains if they are to be competitive in world markets and greatly expand their agricultural exports.

Table 24.--Index numbers of total volume of agricultural exports and imports of developing and developed regions, selected years

(1957-59=100)

Item	:	1955	:	1960	:	1965	:	1967 1/
Developing regions: 2/	:							
Exports	:	108		101		112		106
Imports	:	79		116		141		145
Developed regions: 3/	:							
Exports	:	91		109		149		153
Imports	:	90		107		123		128

1/ Preliminary estimates. 2/ Developing regions include Latin America, Far East (excluding Japan and Mainland China), Near East, and Africa. 3/ Developed regions include Western Europe, North America, Japan, and Oceania.

Source: (30, pp. 29 and 35).

Economic growth of developing countries has depended heavily upon foreign economic aid and private capital investments. The net flow of these resources to developing countries and multilateral agencies totaled \$12.8 billion in 1968, an amount equal to more than one-fourth of the total value of commodity imports (table 26). In the low-income countries, total value of commodity imports has exceeded the total value of commodity exports for several years. In 1968, all imports surpassed all exports by \$2 billion. However, agricultural exports of developing countries exceeded agricul-

tural imports by \$7 billion. In addition, the net flow of resources from developed countries has helped the developing countries finance interest and debt repayments and imports of capital goods.

The net flow of resources from developed to developing countries doubled from 1956 to 1968. However, the Pearson Commission report, *Partners in Development*, (70), indicates that these resources will need to double again by 1975 if the developing countries are to achieve satisfactory economic growth rates.

Table 25.--Total world trade and agricultural commodity trade, by areas, 1968 1/

Item	Developed countries	Developing countries	Eastern trading area	World
- - - - <u>Billion dollars</u> - - - -				
Exports:				
Total				
Total	167.7	43.4	27.1	238.2
Agricultural	30.8	16.6	6.1	53.4
Imports:				
Total				
Total	166.8	45.4	25.9	238.2
Agricultural	38.2	9.2	6.0	53.4

1/ Data are preliminary.

Source: (35, pp. 114-115).

Table 26.--Total net flow of resources to developing countries and multilateral agencies, average 1950-55, and selected years

Resource	Average, 1950-55	1956	1967	1968
- - - - <u>Billion dollars</u> - - - -				
Total				
Official development assistance flows 1/	3.5	6.2	11.2	12.8
Grant and grant-like contributions	1.9	3.3	6.6	6.4
Loans	1.2	1.9	4.4	4.1
Other official flows	.5	.5	2.3	2.4
Private flows	1/	1/	.3	.5
	1.6	2.9	4.2	5.8

1/ Official development assistance data are not available prior to 1960. Therefore, total official flow data are used for the 1950-55 average and for 1956.

Sources: (67) and unpublished preliminary data for 1968.

Chapter V. GREECE: DEVELOPMENT WITH LOW POPULATION GROWTH

By D. C. Myrick and Lawrence A. Witucki

The gross domestic product (GDP) of Greece grew at a compound annual rate of 6 percent from 1948 to 1966, while per capita GDP increased at 5.2 percent. This indicates a strong economy in this small country with modest resources. A slow rate of population growth--less than 1 percent per year--allowed a large proportion of the growth to accrue to per capita incomes. Per capita GNP in 1967 dollars was about \$251 in 1948, and \$683 by 1967.

Total agricultural output grew at the rate of 4.9 percent a year. This was sufficient to meet the needs of population growth, provide for increasing levels of living, accomplish major import substitution, and increase exports of agricultural commodities. At the same time, development of the nonagricultural sector of the economy was such that agriculture's contribution to GDP (GAP) decreased from 28.7 percent to 22 percent.

The Greek experience has relevance to many of the developing countries, especially those that have similar population and resource characteristics. Only about 30 percent of the land area of Greece is arable, and the population is more than half rural. While opportunities for industrial development are modest, this sector is growing. In a relatively short time, Greece has been able to develop a viable economy. Important elements in Greece's success include the very low rate of population growth, a relatively stable government supporting a comprehensive agricultural program, external assistance, a population homogeneous in origin, language, and religion, and a strong determination to progress.

This chapter reviews growth in the agricultural sector and the events and efforts that supported that growth. In retrospect, some policies, programs, and institutions have been deficient in some aspects, and much can be learned from the weak points as well as the strong.

BACKGROUND

Modern Greece is a relatively new nation based on an ancient culture. Its independence was gained from the Ottoman Empire in 1830 after six centuries of Turkish rule, and most of its territory consolidated by the end of the Balkan Wars in 1913. The Turkish occupation left a major mark on the agricultural organization in the mountain villages which were formed when Greeks sought escape from Turkish rule. In 1923, Greece and Turkey agreed to an exchange of nationals left stranded when Greece became independent. To assimilate the returnees, Greece had no alternative but to provide land for as many families as possible. A constitutional limit of 30 hectares per holding enacted in 1952 began the final phase of land reform. The result was an agricultural structure of small owner-operated farms averaging about 3 hectares of cultivated land, with many providing little more than bare subsistence.

Farm size is further complicated by fragmentation of holdings attributed to such factors as equitable distribution of the various qualities of village land, division among heirs, and dowry customs. In 1961, over 95 percent of the farms were subdivided, averaging more than 7 parcels per farm.

Agricultural resources vary widely in Greece. All of the southern part of Central Greece and the Pelopponesus, the islands, and coastal areas of the north have Mediterranean climates, with hot, dry summers and rainy winters. The inland areas of the north have a continental climate--rainy winters with freezing temperatures. The high mountain ranges are cool and wet, providing summer pastures and water for irrigation. Crops in the warmer regions include olives, citrus, grapes, and currants, as well as winter grains. The northern region produces large quantities of grains, tobacco, cotton, deciduous fruits, and table grapes. Here are the important plains areas--former marshes and swamps that have been drained and irrigated, and alluvial flood plains of large rivers that are being increasingly developed by drainage, flood protection, and irrigation. Much of the best hilly, or semimountainous, land is here also. The area of most rapid growth in recent years, the north has the greatest potential for future development.

THE AGRICULTURAL PRODUCTIVITY RECORD

While total agricultural output rose 4.9 percent a year from 1948 to 1966, the area of arable land grew at only 0.8 percent, so most of the increase in output came from intensification. Irrigated land area increased at a rate of 5.8 percent, and was between 16 and 17 percent of the arable land by 1967.

Wartime destruction and disorganization left agricultural output in 1945 far below prewar levels. Crop production and total output recovered by 1949, but livestock herds were not restored until 1954 (fig. 13). Recovery suffered a sharp setback during the internal disorders from 1947 to 1949. After that,

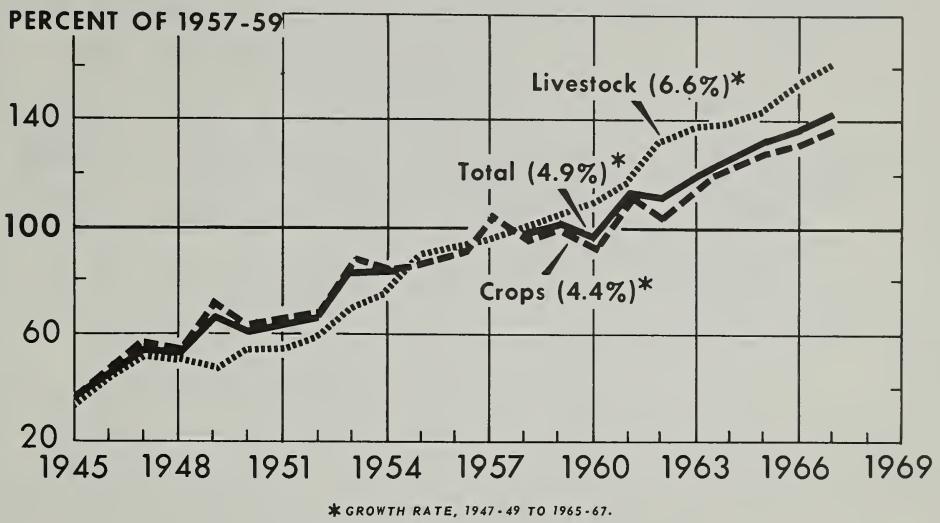
growth was steady and strong. The three northern regions--Thrace, Macedonia, and Thessaly--showed the fastest growth. These regions include relatively large areas of plains capable of irrigation development and other forms of reclamation and improvement. Among the field crops, feed grains grew fastest, from a relatively small base; industrial crops and grains also showed strong growth. Output of vine crops was relatively stable, while tree crop production increased in recent years.

In livestock output, cattle showed the most rapid growth, 9.9 percent per year, followed closely by poultry. Since cattle numbers did not increase much beyond pre-World War II levels, most of the growth was in productivity. Output from sheep started from a large base and grew at an intermediate rate. Growth in output from sheep and goats slowed markedly after 1962-64, while pork production grew rapidly after 1957-59.

From 1948-50 to 1965-67, the value distribution of land, labor, and capital inputs shows that the proportion of both land and labor declined while the share of capital inputs almost doubled (table 27). Rates of growth in the use of fertilizer, seed, and feed, especially the latter, have been outstanding. Other evidence indicates that increased use of feed was the dominant factor in the rapid growth of output from livestock. Since crop and livestock output during the period grew at about 5 percent annually, and total inputs about 2 percent, productivity increased at about 3 percent.

Output per unit (productivity) of land in field crops--grains, forage crops, commercial vegetables, and industrial crops--increased 4 percent a year (fig. 14). Land area increased sharply until 1955, and then essentially stabilized, resulting in an overall growth rate of 1.3 percent from

GREECE: CROP AND LIVESTOCK PRODUCTION

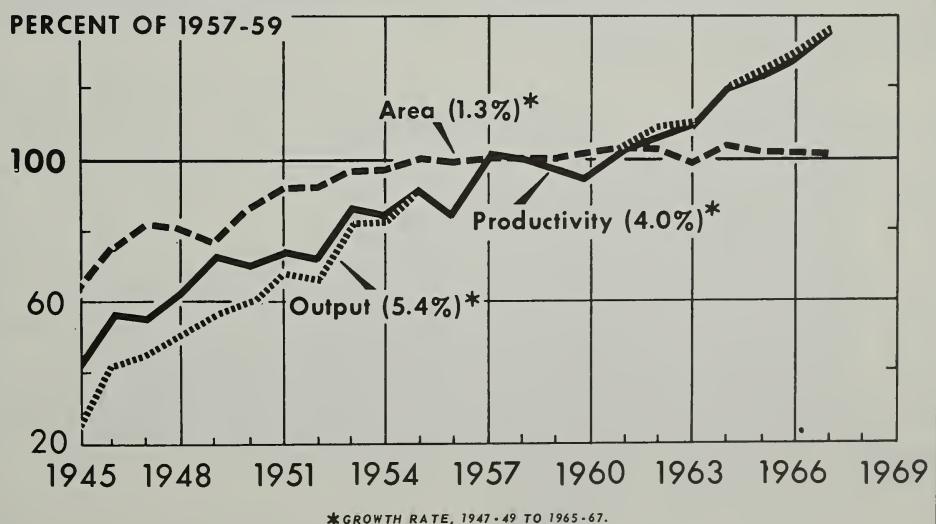


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Figure 13

GREECE: FIELD CROP AREA, OUTPUT, AND PRODUCTIVITY



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Figure 14

Table 27.--Greece: Value, composition, and growth rates of agricultural inputs, selected periods

Item	: Labor	: Land	: Feed and seed	: Fertilizer	: Machinery	: Other capital	: Total
:----- :-----							
<u>Million 1957-59 drachmas</u>							
1948-50	: 14,790	3,520	2,533	295	382	1,242	22,762
1952-54	: 15,504	4,140	3,349	580	397	1,568	25,538
1957-59	: 15,670	4,346	4,465	921	503	1,854	27,759
1961-63	: 15,855	4,433	5,269	1,142	689	2,037	29,425
1965-67	: 15,577	4,378	7,229	1,812	991	2,544	32,531
:----- :-----							
<u>Percent</u>							
:----- :-----							
Growth rates, 1948-50 to 1965-67	: 0.3	1.3	6.4	11.3	5.8	4.3	2.1
:----- :-----							

1947-49 to 1965-67. Output of field crops increased throughout the period, except for annual variations due to weather and a marked leveling off from 1957 to 1963. The growth rate was 5.4 percent. An analysis of the sources of change in output from 1952-54 to 1965-67 attributes 9.1 percent of the increase to expanded area, 15 percent to composition (shifts to higher value crops), and 75.9 percent to yields.

Farm labor productivity is very low in Greece, with each farm family producing only enough food for itself and about one other family. The comparable ratio in the United States is 1 to 16 or 17. Figure 15 illustrates the level of productivity by contrasting per capita shares of the GDP that accrued inside and outside the agricultural sector. Between 1949 and 1967, per capita GDP grew at 5.1 percent a year, from about \$235 to \$540 in 1958 dollar equivalents. GAP per person in agriculture grew at the rate of 4.4 percent, starting from a low base and remaining low. This is in marked contrast to the implied productivity of the population out-

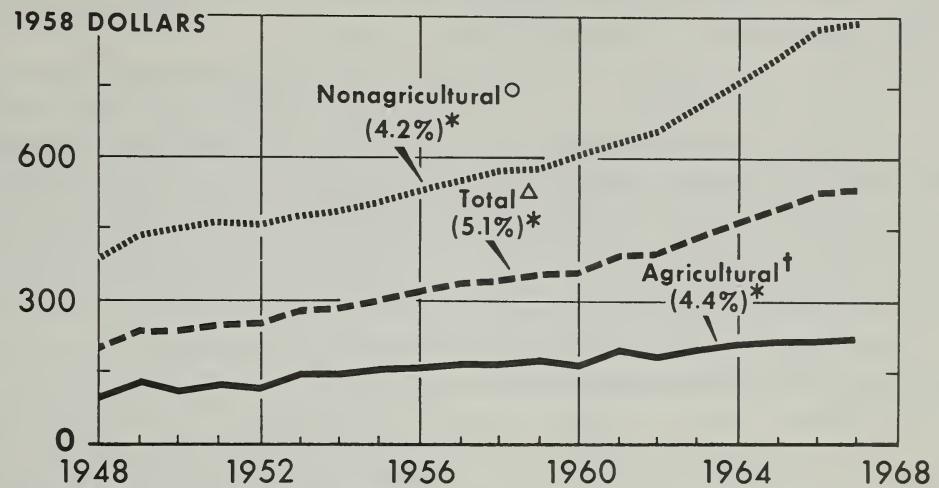
side agriculture, which, although growing at about the same rate as GAP per person in agriculture, started from a high base and achieved large absolute gains.

THE ROLE OF AGRICULTURE IN THE NATIONAL ECONOMY

Growth of agricultural output lagged behind the rest of the Greek economy (fig. 16). GDP from agriculture increased 4.3 percent annually from 1948-50 to 1964-66, while total GDP increased 6 percent annually. Manufacturing, starting from a small base, grew at the rate of 8.8 percent. In 1948, the agricultural sector generated 28.7 percent of the GDP, and manufacturing 10.8 percent. By 1967, they were 22 percent and 18.6 percent, respectively.

The proportion of the population in agriculture declined from 63.5 to 52.4 percent from 1948 to 1967. This sector continued to provide the major means of

GREECE: PER CAPITA GROSS DOMESTIC PRODUCT

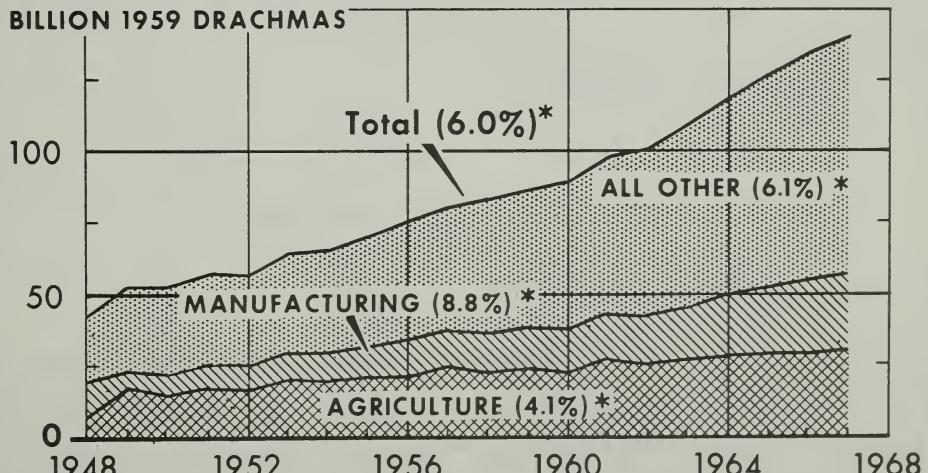


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Figure 15

GREECE: SOURCES OF GROSS DOMESTIC PRODUCT



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Figure 16

livelihood for large numbers of people who could not find other employment. Many Greek farmers participate only marginally in the market economy. They are a reservoir of manpower with unused potential for development of themselves and the economy.

From 1953-55 to 1964-66, total imports increased 8.3 percent annually and exports 4.6 percent; thus the already unfavorable balance worsened. Agricultural exports increased at the rate of 3.9 percent, and continued to contribute the major share of total exports. Agricultural exports also continued to exceed agricultural imports (table 28).

Emigrant remittances were important in offsetting part of the negative trade balance. Increasing at the rate of 20 percent from a very small base, these remittances often equaled one-third of the

negative balance of trade, services, and the like. In 1963, they exceeded one-half. A substantial proportion of the emigrants who sent money to their relatives in Greece were from the agricultural sector.

The national diet and expenditures for food reflect growing incomes (table 29). The proportion of food expenditures for bread, cereals, oils, and fats declined significantly from 1950 to 1966, while the proportion spent for animal-derived foods and beverages increased rapidly (the latter from a relatively small base). The income elasticity of demand for breads and cereals and fats and oils was negative, -0.14. On the other hand, for animal-derived foods, it was 1.33. These diet changes emphasized more expensive foods, and were reflected in imports as animal-derived foods and livestock feed became major import items. The elasticity of demand for all foods was 0.6, with the proportion of national income spent for food declining.

Table 28.--Greece: Agricultural exports and imports, and trade balances, selected years

Year	Agricultural commodities		Net commodity balance 1/	Imports of agricultural inputs 2/	Net agricultural balance 3/
	Exports	Imports			
- - - - Million 1958 drachmas - - - -					
1953	3,677	2,989	688	236	452
1957	5,703	4,276	1,427	739	688
1962	5,581	3,162	2,419	800	1,619
1966	7,302	4,935	2,367	1,060	1,307
Total, 1953-66	76,966	52,802	24,164	11,230	12,934

1/ Exports less imports of agricultural commodities. 2/ Includes fertilizers and materials, SITC groups 271 and 561, and agricultural machinery SITC group 712. Chemicals and various minor items are omitted. 3/ Exports less commodity and inputs imports.

Source: Based on data from (39)..

Table 29.--Greece: Composition of food expenditures, income elasticities of demand, and income spent on food, selected years

Commodity group	Composition of food expenditures					Income elasticity of demand <u>1/</u>
	1950	1954	1958	1962	1966	
	Percent	Percent	Percent	Percent	Percent	
	Percent	Percent	Percent	Percent	Percent	
Breads, cereals, oils, fats	40.6	35.6	31.3	27.6	22.0	-0.14
Foods of animal origin	25.7	28.3	34.1	39.4	43.9	1.33
Fruits and vegetables	26.5	28.7	26.5	24.3	25.3	.43
Coffee, tea, cocoa, etc.	1.4	1.4	1.5	1.8	1.9	1.10
Sugar and confectionery	5.1	5.2	5.8	6.2	6.2	.98
Other food	.7	.8	.8	.7	.7	.57
Total food	100.0	100.0	100.0	100.0	100.0	.60
Food as proportion of net national income	46.0	43.1	39.5	36.6	33.2	---

1/ Calculated from annual data series.

Source: Computed from data in (37), and (38).

INSTITUTIONAL STRUCTURE

In addition to research institutes to supply technology for farmers and the Extension Service, the Government, including the Ministry of Agriculture, established other institutions to further the development of agriculture. The Land Mechanization Service aided in development of irrigation on farms and mechanization of operations. Another example is the Regional Development Service of Northern Greece, which served principally in a planning and advisory capacity.

The Agricultural Bank was set up in 1929 to help with assimilation of returning population and agrarian reform. It became the key institution through which the Government effected its policies and operated its action programs in agriculture. Its major functions were to: (1) supply credit to farmers and cooperatives, (2) provide farm supplies,

(3) assist cooperatives in their operations, and (4) promote technology and provide insurance. Of the Bank's "Directorates," three were major: Credit, to handle loan operations; Cooperative, to supervise the cooperatives; and Technical, to aid borrowers in commodity, organization, and management problem areas. The Bank became one of the strongest economic forces in the country.

Both the crop and collateral loans advanced by the Bank were short-term credits to individual farmers (table 30). Short-term loans to cooperatives financed purchasing, processing, storing, and marketing of commodities. The medium- and long-term loans ran from 2 to 20 years, with medium-term loans greatest in value. Total loans in 1952-54 were 13.5 percent of GAP, and 23.0 percent in 1964-66. Interest rates were low, about 4-6 percent to farmers depending

Table 30.--Greece: Type, value, and growth rates of loans advanced by the Agricultural Bank, 1952-66

1/ Includes cooperatives, but amounts to Athens headquarters not included.

2/ Includes lending to cooperatives.

Source: Agricultural Bank of Greece.

upon the type of loan. These were above the 3-percent rate of inflation, but well below the Bank's 6 to 7 percent operating costs.

About 90 percent of the farmers used short-term credit each year. Of this credit, about 30 percent was in kind, in the form of fertilizer and other inputs. The Bank had a virtual monopoly on fertilizer distribution.

Thus, through this critical development period, the Agricultural Bank was the center of the coordinated institutional structure that included the system of cooperatives and Extension. In addition, the Bank made credit available in sufficient volume to buy the inputs that it supplied and subsidized, implemented agricultural policies and programs, assured markets and controlled prices, and developed domestic sources of inputs. With

adequate financial support from the Central Government, the Bank was a key factor in the high rate of growth of the agricultural sector. Table 31 shows the growth in value of inputs of seeds, fertilizer, and pesticides from 1948 to 1966. Fertilizer was the major input purchased during that period.

The second major action agency was the system of cooperatives, in effect guided and controlled through the Agricultural Bank, which also financed its operations. The first-degree cooperatives were the local units, limited by law in scope to the commune. These were small in scale of business and financial resources, most having neither a shop nor paid secretary. Their primary function was to serve as "an office of the Agricultural Bank brought to the farmer's door." Other services of the local cooperatives included distribution of

fertilizers, pesticides, and household supplies. Although weak at the local level, cooperatives facilitated the entry of small farmers into the market economy.

There were about 130 second-degree cooperatives providing the basis for the real cooperative movement. These were regional unions, representing 6,350 first-degree cooperatives. Among the services they supplied to member cooperatives was bookkeeping.

Table 31.--Greece: Value and growth rates of seed, fertilizer, and pesticides used, selected years

Item	Seed	Fertilizers	Pesticides
: - <u>Thousand 1958 drachmas</u> -			
1948	766,088	189,000	34,200
1953	937,103	414,000	84,197
1958	1,021,624	862,550	127,529
1962	1,099,144	1,161,026	314,399
1966	1,162,340	1,858,000	224,514
: - - - <u>Percent</u> - - -			
Growth rates, 1948-50 to 1964-66	2.4	13.7	10.4

Source: Office of National Accounts, Athens.

The third-degree cooperatives provided specialized services. The Cooperative Unions Pool for Handling Home Produce (KYDEP) was the most important. It handled three-fourths of the wheat collected, mostly on behalf of the State, purchasing it at guaranteed prices and supplying it to flour mills. It collected 10 percent of the cotton grown and organized its export. It was also responsible

for marketing certain vegetable products for which there were no central unions. KYDEP had a State monopoly for the importation, collection, and distribution of cotton, potato, and other seeds.

Most major products were represented by central cooperative unions involved in a variety of activities, especially marketing and processing. The central unions usually handled only a fraction of the product, sufficient to maintain support-price levels, set standards for the industry, and absorb surpluses in years of high production.

At the top of the cooperatives' structure was the Panhellenic Conference of Agricultural Cooperative Unions. This organization supported and directed the cooperative movement nationally, and was the only single effective pressure group for agriculture as a whole. In general, there were few organizations in which Greek farmers could become involved. Cooperatives might have provided the main opportunities for participation, but they were weak at the local level.

Greece became an associate member of EEC in 1962, with full membership projected for about 1986. Harmonization led to some changes in internal pricing policies, but most important, EEC trade provisions helped Greece to enter and compete in European markets. Turkey is also an associate member, and 18 African countries enjoy trade preferences on competing tropical products. Greece has locational advantages and an early start in marketing in Europe, but will face increasing competition from a large and diverse area.

The marketing system evolved from traditional organizations and facilities oriented to subsistence and local markets. This system was difficult to restructure in relation to a rapidly developing commercial agriculture based on small farms. Early in the development period, a major road construction program provided access to markets and facilitated wide distribution of inputs such as fertilizers and feed grains that became available under Public Law 480. The cooperatives have contributed materially toward developing markets and marketing systems and setting standards. However, many problems persist, especially in meeting export requirements for fresh fruits and vegetables. Even the relatively new system of roads is becoming obsolete.

LAND AND WATER RESOURCE DEVELOPMENT

Development of the land base increased arable land area and the productivity of land already in use, and facilitated the application of advanced technology. External assistance and State programs were intensively involved in

these projects. Increases in arable land after World War II required modern equipment and technology for reclamation projects including drainage, flood protection, desalination, clearing, and irrigation. From 1949 to 1954, land area in field crops increased 3.5 percent a year. The major activities were flood protection of 300,000 hectares and well irrigation of 190,000 hectares.

The irrigated area increased 5.8 percent a year from 1950 to 1965-67, and by 1967 it approached 17 percent of the arable land. Irrigation projects under construction in 1965 involved some 115,000 farms. Irrigation has been a primary means for increasing the land base in recent years, and expansion is expected to continue at a relatively high rate for several years (table 32).

Land development followed a rational course. Relatively inexpensive activities were undertaken first--drainage, land clearing, flood protection, and individual or small private irrigation projects with diversions or wells. The present stage

Table 32.--Greece: Areas of selected irrigation projects under construction, 1965, and proposed for development, 1966-70

Project	Expected area to be developed				Area irrigated	
	Irrigation	Drainage	Flood	Reclamation	1965	1966-70
			control			Expected
- - - - Thousand hectares - - - -						
26 projects under construction in 1965	253	218	125	54	63	108
					1/(7)	
29 projects proposed 1966-70	225	49	7	10	1/(11)	42
						1/(11)

1/ Presently privately or partially irrigated, and to be improved.

Source: (50).

of development requires major basic installations. Since priorities were not rigorously established and resources were widely dispersed to start a large number of projects, few installations have been completed.

Consolidation of fragmented holdings is a major concern of the Government. The program from 1953 through 1958 was voluntary in nature, whereby a village could request consolidation, after which the Government would provide assistance. In 1959, an involuntary program was added, requiring consolidation in advance of major Government-supported irrigation and other land development projects. Through 1967, 197 villages, involving 140,000 hectares, were consolidated voluntarily, and 176 villages (90,000 hectares) under the involuntary program. Until 1961, consolidation was active only in Central Greece, Thessaly, and Macedonia. Estimated costs were about \$45 per hectare, and \$25 more if access roads were constructed. These costs were borne by the Government.

TECHNOLOGY

Greece emphasized adaptive crop research immediately after World War II with considerable success, but basic research is now dominant. An early-maturing cotton variety developed by the Cotton Institute, especially needed in northern Greece, was being grown on 75 percent of the cotton area 3 years after its release. Fifteen wheat varieties are available for the various environments in which the crop is produced. Hybrid corn varieties have been produced for all of the corn-growing areas of Greece, and have proved productive in other eastern Mediterranean countries as well.

Livestock research, and the resulting technology and programs for its dissemination, came only recently, and did not anticipate the increasing demand for animal-derived foods associated with economic growth. Consequently, the livestock products being imported to supplement inadequate domestic supplies are absorbing foreign exchange. Greece has a relatively new Livestock Institute and several related "stations" that are carrying on adaptive and basic research and supplying supporting services such as artificial insemination.

The Land Equipment Branch of the Land Mechanization Service provides technical assistance and financial support for mechanization and land improvement. This agency is also concerned with determining the combinations of land improvement and technology needed to develop the potential productivity of fertile lands. In 1950, there were about 5,400 agricultural tractors in Greece. By 1966, these had increased to about 67,000, one-third of which were single-axle or garden type machines, especially adapted to small farms, small fields, and semimountainous land. Thus, the major use of power has developed in the level and fertile lands.

Technology was disseminated through two almost parallel general channels, plus the programs of specific commodity groups. The Extension Division was established in the Ministry of Agriculture in 1950 with U.S. assistance. The staff has varied between about 325 and 400 since 1955. Each field agent was responsible for 15 to 20 rural communities containing some 2,500 farm families. Although the Extension Division preferred to work with groups and through mass media, its young farmers' clubs, meetings, and short courses did not reach enough people. At the same time, the

agents were overburdened with responsibility for implementing Government action programs, which required dealing with individual farmers. Unlike many developing countries, the Greek extension service had materials for an educational program, but other responsibilities reduced its effectiveness.

The Agricultural Bank provided the other channel through its Technical Services Division, which was slightly larger than the Extension Division of the Ministry. Each Bank technician processed over 1,000 loan applications a year, and was expected to give advice on the use of fertilizers, seeds, new cropping practices, and livestock management, making the loans partially supervised credit. In practice, the volume of loan processing limited the technical services generally to allocation of fertilizer with each loan.

Education and training are fundamental to the ability to develop, disseminate, and assimilate technology. Greece had a high level of literacy--in 1961, 82.2 percent for persons 10 years

old and over. Degree of literacy was lowest in rural areas, and persons with education beyond the primary level were concentrated in the cities (table 33). Persons with agricultural or technical training at the secondary level, or university training in agriculture, were few in number. Efforts are being made to break down the bias toward classical education at all levels, and attract larger proportions of the young people into technical training and specialized branches of university education.

INVESTMENT IN AGRICULTURE

Data on total fixed capital in agriculture are not available, but the amount and sources of growth in the formation of "fixed assets" in agriculture are significant (fig. 17). In 1948, the total addition was only a little over 0.5 billion 1958 drachmas. The increments then increased sharply, dropped in 1952, and again grew rapidly after 1956, with private investment increasingly dominant. In both 1965 and 1966, fixed assets equal to almost 4 billion drachmas were formed

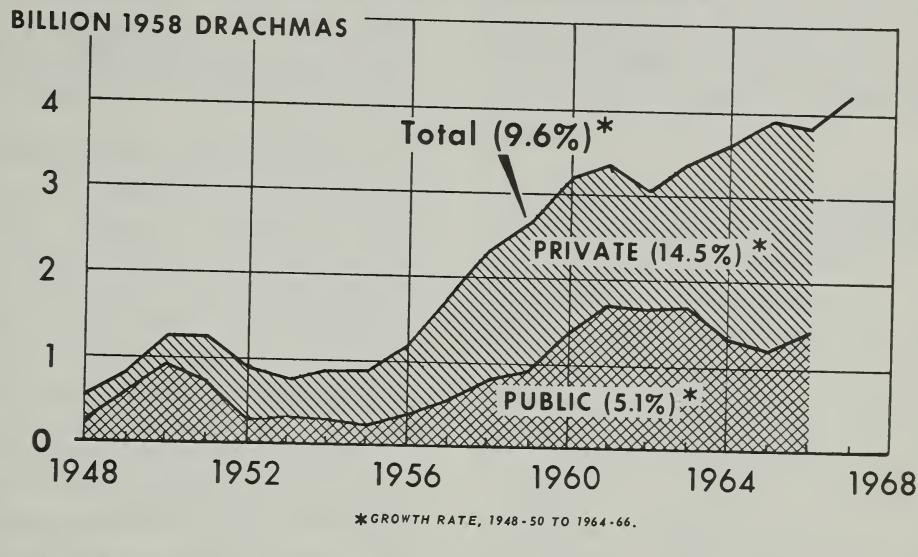
Table 33.--Greece: Education and literacy levels of persons aged 10 years and over, by degree of urbanization, 1961

Urban- ization type	Population distribution	Level of education attained						Level of literacy
		Higher			Primary	not declared	Not completed	
		Secondary	Primary	not declared	Not completed			
<u>Percent</u>								
Urban	44.8	3.1	14.3	46.7	35.4	0.5	88.2	
Semi- urban 1/	12.9	1.2	4.1	43.5	50.9	.3	81.5	
Rural	42.3	.6	1.6	39.8	57.6	.4	76.1	
Total	100.0	1.8	7.6	43.4	46.8	0.4	82.2	

1/ Centers of 2,000-9,999 outside urban agglomerations.

Source: (39).

GREECE: GROSS FIXED ASSET FORMATION IN AGRICULTURE



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Figure 17

in agriculture. Public investment exceeded private the first few years, and still accounted for 38 percent of the investment in agriculture in 1963-65. In these years this was 28 percent of total public investment, excluding Agricultural Bank loan funding, while agriculture's proportionate contribution to GNP was 24 percent. Land development, including irrigation, drainage, land leveling, consolidation of holdings, and road construction, were important public investment areas.

PRICES

The Government managed prices of agricultural products and inputs to increase output generally and to encourage production for import substitution and export. The price policies evolved into a complexity of price supports and controls, and bonuses and subsidies for

farmers, processors, exporters, marketing and storage agencies, and consumers. Special income supports were provided for operators of small farms who could not find other economic opportunity. The cost of these programs in 1965 was about 6.2 percent of the GAP. The high rate of growth of agricultural output reflects the response to these price policies.

Prices of agricultural products increased under these policies at about the same rate as prices in the economy as a whole (table 34). Without them, the terms of trade could have shifted sharply against agriculture.

Prices to farmers of purchased inputs were favorable. For example, the number of kilograms of rice or wheat

required to purchase a kilogram of average fertilizer nutrient was the least in Greece among the six countries studied intensively (table 18). The Agricultural Bank subsidized between 10 and 30 percent of the cost of fertilizers and sold them at uniform prices to all farmers, regardless of location relative to supply sources.

Table 34.--Greece: Indexes of agricultural and general price levels, selected periods 1/

(1958=100)

Item	: Gross : agricul- : tural : product	: Gross : domestic : product
1948-50	: 53	49
1952-54	: 78	75
1957-59	: 98	99
1961-63	: 111	109
1964-66	: 127	120
	:	
	: - - - Percent - - -	
Rate of increase,	:	
1948-50 to	:	
1964-66	: 5.6	5.8
	:	

1/ Implicit price deflators for GAP and GDP calculated from (37) and (38).

EXTERNAL ASSISTANCE

Three years after independence, in 1833, Greece incurred its first foreign debt--a bonded debt guaranteed by France, England, and Russia. Additional capital was borrowed from time to time through both bonded debt and intergovernmental loans, for various purposes including construction of railroads. A series of loans in the 1920's supported settlement of refugees after the exchange of populations with Turkey. Loans in the 1930's were

for land development, except one from Germany in 1937 for defense. Greece had problems before World War II in servicing this debt accumulated in the century following independence. Between 1960 and 1966, the prewar debts were "settled" by negotiating balances owed and arranging servicing schedules.

At the end of World War II, when the survival of Greece as a free nation with a viable economy was in doubt, reconstruction was undertaken with strong support from external sources. In the critical period from 1945 to 1949, basic subsistence, restoration of productive capacity, and political organization were emphasized. The latter was supported by military assistance and is not discussed in this report. Initial support for the other objectives was provided by Britain until the scale of the assistance required exceeded British means. The United States then took over the responsibility, with several sources involved during the UNRRA period. About 1.2 billion dollars were committed in this period by various countries and programs.

Long-term development programming was begun in 1949, when the immediate goal of reconstructing the prewar economy was considered inadequate. The new longer term agricultural program comprised flood control and irrigation, technical services, better use of feed, fertilizer, and equipment, mechanization in appropriate areas, and improvement of marketing facilities. It was originally proposed as a 4-year program, but it was recognized that it might take longer. It was a grant program under the Marshall Plan through 1952, and under the Mutual Security Act through 1954. Loans for development projects were added in 1955. When the U.S. aid program in Greece was virtually terminated in 1965, loans had become about 40 percent of the input.

Of the gross investment financed by U.S. aid from 1948 to 1953, 11.2 percent was for agriculture and 11.4 percent for reclamation. Amounts used for various agricultural development activities were not clearly reported after this period, but the following are typical examples. Counterpart funds equivalent to \$3,600,000 were provided for the Agricultural Bank in the Marshall Plan Period. Additional amounts, in direct and counterpart funding, built the total to \$117 million by 1964. Training outside Greece was supported by the United States for 774 persons, 180 of these in agriculture. Above \$1 million was used to develop research and related programs. Almost 1,000 schoolrooms were built and 3,800 repaired, as well as assistance provided to expand higher education in agriculture. A project loan of \$11.9 million, repayable in drachmas, financed the foreign exchange costs of the nation's first nitrogen plant.

Assistance averaged almost 10 percent of GDP from 1949 through 1952, decreasing to nearly 4 percent through 1957 (table 35). The sheer scale of this

input had a major effect on the economy, especially in the early period when it and counterpart funding made up a large proportion of the total investment. After 1957, when external assistance was only about 1 percent of GDP and internal saving financed most investment, the effectiveness of external aid depended upon support of critical projects.

The composition of Public Law 480 exports to Greece from 1955 through 1966 was about 33 percent wheat, 45 percent feed grains, 3 percent dairy products, and 19 percent fats and oils (table 36). The P.L. 480 program came after financial stability was achieved and the country was in a position to benefit from this type of assistance. The need was real because economic aid had been cut back and development resources were scarce. The scale of P.L. 480 was limited principally by the capacity of the country to absorb the commodities that were available.

The Title I program supplied mainly wheat through 1959. These shipments did not interfere with domestic production,

Table 35.--Greece: Average GDP, U.S. and other assistance, and proportion of GDP, selected periods

Period	:	GDP of Greece	:	Total U.S. assistance	:	Loans assistance,	:	Total assistance
						other sources	:	Amount 3/
						3/		
	:			-----	Million dollars	-----		- Percent -
	1949-52	:	7,330.0	689.8	32.5	722.3		9.8
	1953-57	:	11,922.4	424.6	9.0	433.6		3.7
	1958-66	:	<u>31,577.1</u>	<u>306.7</u>	<u>42.5</u>	<u>349.2</u>		<u>1.1</u>
	Total	:	50,829.5	1,421.1	84.0	1,505.1		3.0
		:						
	1/							
	2/							
	3/							

1/ Based on constant 1958 drachmas, converted at the rate of 30 drachmas per dollar.
2/ Successively Marshall Plan, Mutual Security Act, and AID., plus P.L. 480 after 1955. The series has been adjusted to 1958 dollars using the U.S. total gross national product deflator. 3/ Adjusted to 1958 dollars--see footnote 2.

Sources: GDP from (37) and (38); U.S. assistance from (3, p. 16) and (23, table 10); other lending from (39).

Table 36.--Greece: U.S. agricultural exports to Greece under specified Government-financed programs, selected periods

Period 1/	Public Law 480				Mutual Security Long-term supply & Barter dollar credit sales	Act and AID programs	Total program exports
	Title I Sales for foreign currency	Title II Emergency relief	Title III Foreign donations	Title IV			
- - - - <u>Million dollars</u> - - - -							
1955-58	50.0	0	42.7	11.7	0	78.9	183.3
1959-62	38.0	1.4	24.4	2/	0	2.6	66.4
1962-66	30.8	0	17.5	8.5	23.5	.7	80.9
Total	118.8	1.4	84.6	20.1	23.5	82.2	330.6

1/ Years ending June 30. 2/ Less than \$0.05 million.

Source: (23, table 10, page 93).

rather they supplemented supplies until domestic output could meet the needs. Under this program, wheat was imported by the Government and sold to the mills at domestic support prices, thus providing additional revenue for supporting prices without affecting internal price levels. Increasing feed grain imports stimulated the relatively stagnant livestock industry, providing large quantities of feed grains for the first time. The gains in livestock management more than offset the depressing effect on domestic production resulting from sales of P.L. 480 feed grains at c.i.f. costs.

Less than 60 percent of the local currencies generated under Title I were turned over to the Greek Government for use in development projects, while the program average in all countries was 70 percent. The United States, of course, used much of the retained currencies for development-oriented activities of its local Mission.

Most presently developing countries benefited from capital support of direct

development investment before World War II as trading partners, members of large political or colonial complexes, or as sources of raw materials, paralleling the series of loans Greece obtained for development purposes. However, few have experienced the massive support that Greece received in the immediate postwar period. Most countries have been receiving U.S. assistance only since 1955 or later, in programs with large components. Assistance to these countries tended to increase from 1960 through 1966, but at comparatively minor levels, compared with GNP. After the high initial inputs, Greece continued to participate for more than a decade in this later type of program.

An outstanding characteristic of the Greek experience with external assistance was the nation's ability to assimilate a large volume of aid effectively. Efforts to restore prewar productive capacity required investment that did not involve change and growth. After restoration was accomplished, Greece was able to adjust to the problems of development and growth. In contrast, many developing countries

cannot effectively use the financial and technical assistance available to them.

FIVE-YEAR DEVELOPMENT PLAN

Greece's 5-year development plan for 1968-72 sets forth goals and major problems, and details the means of attaining those goals. It is especially relevant as a planning document because it reflects the country's approach to development. The goals are high, but attainable with good management and determination. The plan continues the changes in institutional structure and economic environment appropriate to reaching the national goals and to adjusting to the level of maturity the economy has attained.

Greece's basic goal is an overall annual growth rate of about 8 percent, with changes in the composition of production, investment, and trade, and the creation of 350,000 new employment opportunities. The latter includes increasing total employment by 190,000 workers with 110,000 coming from the agricultural sector. The other 160,000 new jobs are to provide opportunities for people presently in relatively unproductive positions.

The agricultural plan calls for an overall growth rate of 5.2 percent, with livestock growth at 7.6 percent, and crops at 4.7 percent. This would increase livestock's share of output from 30 percent in 1965 to 35 percent in 1972. Agriculture's problems are structural weaknesses--a large proportion of low-yield crops with low income and price elasticities of demand, insufficient livestock output, and a disproportionate share of the population--50 percent--engaged in agriculture but contributing only one-fourth of the national output.

Productivity

Under the 5-year plan, productivity of the agricultural population is to be raised by enlarging, consolidating, and reorganizing farms; creating a land market supported with credit; more mechanization; increasing the proportion of arable land under irrigation--from between 16 and 17 percent to 20.4 percent, with heavy public investment and subsidies; and restructuring of agriculture. The latter will include less intensive use of mountainous terrain and poor soils, and recognition of Greece's comparative advantages. Plans also include the modernization of research, further adaptive and varietal development of all crops, qualitative and quantitative refinement in the use of fertilizers and pesticides, increased education and selective specialization at all levels, and expansion of extension services. Livestock development is to be given special attention under the plan.

By transfers out of agriculture and increased output, farm labor productivity is expected to increase at a rate of 6.5 percent--substantially more than output for the sector. Underemployment of those remaining in agriculture with small resource bases will be ameliorated by reducing the seasonality of production and providing supplemental employment of various kinds. The Government plans to continue income redistribution through income transfers and expanded social services.

Markets

Expanded production will be partially absorbed by demand arising from increased incomes. Programs of import substitution and export marketing will also be required. Imported meats are

to be reduced from 30 to 5 percent of consumption, and dairy products from 10 percent to almost zero. Marketing facilities, especially export channels, are to be modernized. Export programs will emphasize citrus, other fruits, table grapes, cotton, and the traditional tobacco and dried fruits. A major concern is to move in the direction of full harmonization with the EEC, to take advantage of its market potential; plus its program of financing of structural changes.

Institutions and Organizations

The Agricultural Bank will be reorganized as a credit institution, with transfer of its technical assistance to

Extension, its control over cooperatives to another agency, and its supply functions to private business (including cooperatives). However, the Bank will use its credit policy to influence the pattern of cultivation.

Cooperatives are to be strengthened by combining locals into larger units, emphasizing productive services rather than credit, making them more competitive with other private business, and lessening their quasi-governmental nature. Regional branches of the Ministry such as Extension, Land Reclamation Service, and research institutes will be expanded, and technical personnel relieved of administrative duties.

Chapter VI. TAIWAN: DEVELOPMENT WITH RAPID POPULATION GROWTH

By R. P. Christensen

Taiwan achieved rapid economic growth after World War II despite high population growth, limited natural resources, and large expenditures for defense (13). National income measured in real terms increased 8.2 percent a year from 1951 to 1968 (12). Per capita income increased 4.8 percent a year and averaged a little over \$230 a year in 1968. Population growth was very rapid in the early 1950's, over 3.5 percent a year, but it decreased to 2.7 percent in 1968.

Most people in Taiwan consume nutritionally adequate diets and enjoy good health facilities. Life expectancy at birth is 66 years, compared with 70 years in the United States. Approximately 97 percent of the primary school-age children attend school, and 75 percent of the total population are literate.

Taiwan has only 0.17 acre (0.07 hectare) of cultivated or arable land per person, about the same as Japan and the Netherlands, compared with 2 acres in the United States. But agricultural land is used intensively, and crop yields have been raised to very high levels. In fact, crop production per acre averages about six times higher in Taiwan than in the United States. About two-thirds of the arable land is irrigated and often grows three or four crops a year.

Economic growth in Taiwan was heavily dependent upon improvement in agricultural productivity. Total agricultural output increased 4.4 percent a year during 1950-68. High growth rates in agricultural output also were achieved during the 1920's and 1930's. Therefore,

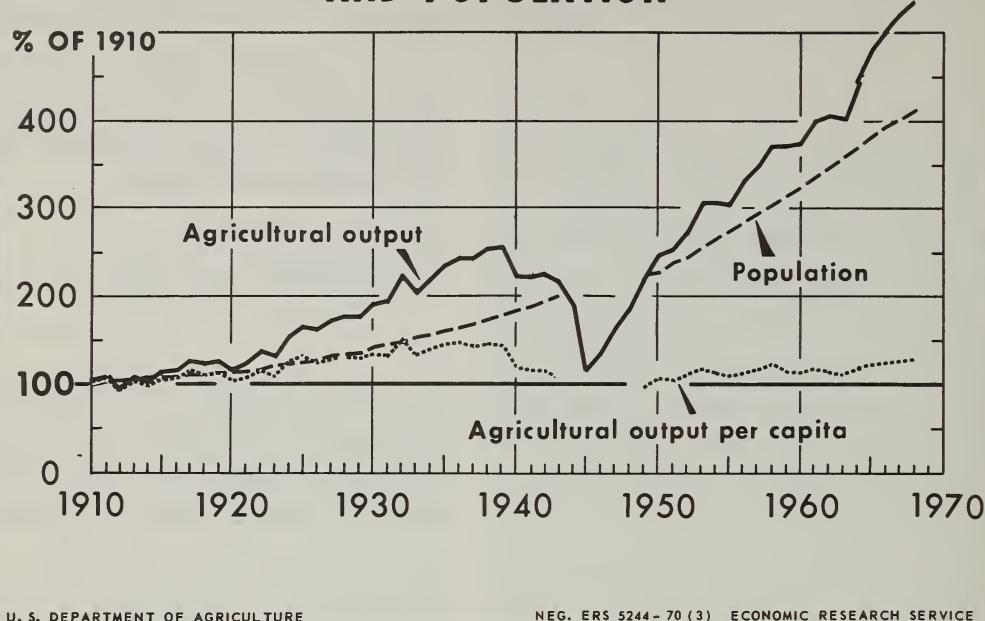
it is useful to review Taiwan's agricultural development record before World War II as well as afterward.

GROWTH IN AGRICULTURAL OUTPUT AND POPULATION

As in most developing countries today, population growth rates increased in Taiwan during the early stages of its economic development. Population growth rates increased from 1.3 percent a year in 1910-20 to 2.3 percent a year in 1920-30 and 2.7 percent in 1930-40. Death rates declined, while birth rates remained high. However, agricultural output increased more rapidly than population (fig. 18). Total agricultural output increased 2.2 percent a year in 1910-20, over 4 percent in 1920-30, and about 4 percent in 1930-39. Agricultural production per capita averaged 40 percent higher in the late 1930's than in 1910.

Taiwan was under Japanese colonial rule from 1895 until 1945, when it was restored to China. An energetic agricultural development program was carried out under the Japanese. New varieties of rice, sugarcane, and other crops were introduced from abroad. Adaptive research to develop varieties suited to Taiwan's conditions was carried out. Irrigation, marketing, and transportation facilities were constructed. A large share of the expansion in agricultural production was exported to Japan. Rice exports reached a record high in 1934, when 56 percent of total rice production was exported. In 1939, 90 percent of the sugar produced was exported, setting

TAIWAN: TOTAL AGRICULTURAL OUTPUT AND POPULATION



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Figure 18

another record high. Food consumption levels per person in Taiwan did not increase much during the Japanese colonial period.

Agricultural production dropped drastically during World War II. Damage to irrigation systems and lack of fertilizer and other production requisites, together with other unfavorable conditions, caused total agricultural output to drop 60 percent to about the 1920 level. However, agricultural production recovered quickly after 1945 and reached the 1939 prewar peak in 1950.

Total population increased 1.5 million from 1940 to 1950, due in large part to immigration from Mainland China. Population growth accelerated to record high rates after 1950 as death rates declined further and birth rates remained

high. The population growth rate increased to 3.6 percent a year in 1950-60. It remained high in the early 1960's, but decreased to 2.7 percent in 1968 due to lower birth rates.

Agricultural output increased 4.3 percent a year in 1950-60 and 4.5 percent a year from 1960 to 1968. The high growth rates in agricultural output after 1950 are especially remarkable, considering that potentials for obtaining large increases in production by expanding land area under cultivation and increasing irrigated area had been fully exploited by 1945.

Because of rapid population growth, agricultural output per capita was lower in the 1950's and 1960's than in 1930-39. In recent years, agricultural output per person averaged only about 20 percent

larger than in 1910-20; in 1930-39, it was 40 percent higher. A smaller share of total agricultural output has been exported in recent years than the 1930's. For example, exports accounted for 45 percent of total food production in 1935-39, compared with only 12 percent in 1961-65. Per capita consumption levels for food and other commodities have increased with rising per capita incomes.

Emphasis was placed upon expanding crop production during the early years of development. However, since the early 1950's production of livestock and poultry products has increased far more rapidly than production of crops (table 37). A large part of the expanded output of livestock products has been based upon imported feeds. Expansion in livestock and poultry production has been mainly for domestic consumption.

Table 37.--Taiwan: Index numbers of agricultural production, selected periods

Period	Total agricultural production	Crop production	Livestock production
<u>Percent</u>			
1911-15:	100	100	100
1936-40:	230	234	198
1951-55:	270	273	251
1961-65:	396	386	459

Source: (13).

GROWTH IN AGRICULTURAL PRODUCTIVITY

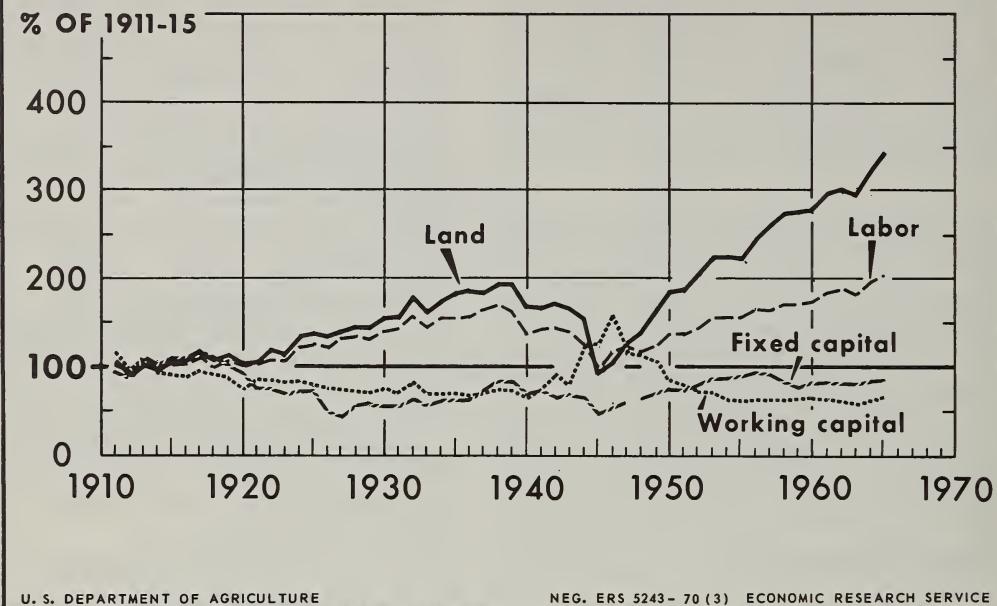
Taiwan has an outstanding record of increasing agricultural productivity

(fig. 19). Total agricultural output per unit of land, labor, and capital combined was 45 percent larger in 1935-39 than in 1911-15, and 101 percent larger in 1961-65 than in 1911-15 (table 38). Real costs per unit of agricultural output averaged 50 percent lower in 1961-65 than in 1911-15. Increased productivity or efficiency in the use of farm resources accounted for about one-half of the 300-percent increase in total agricultural output from 1911-15 to 1961-65. Use of additional inputs, mainly labor and capital, accounted for the remainder. The rapid overall growth in agricultural productivity since 1940 is especially significant since agriculture has had to provide employment for increasing numbers of workers. From 1940 to 1965, the agricultural labor force increased 2.7 percent a year.

Agricultural output per unit of land averaged three times as high in 1961-65 as in 1911-15. Agricultural output per unit of labor input was nearly twice as high. The area under cultivation increased 25 percent from 1911 to 1939, but only 4 percent from 1939 to 1965. However, total harvested crop area has risen 50 percent since 1939, due to increased multiple cropping. The number of days employed per agricultural worker has increased about one-third. Consequently, agricultural output per worker has increased more than agricultural output per unit of labor input. More multiple cropping and increased emphasis on livestock production have helped to make possible the fuller use of available labor.

Large inputs of capital have been required to increase output per unit of land and labor. Farm purchases of fertilizer, pesticides, and other materials from non-farm sources have soared. Consequently, agricultural output has declined per unit of fixed and working capital (table 38).

TAIWAN: AGRICULTURAL OUTPUT PER UNIT OF INPUT



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Figure 19

Table 38.--Taiwan: Index numbers of agricultural output per unit of all resources, land, labor, and capital, selected periods

Period	Agricultural output per unit of input of--				
	All re-sources	Land	Labor	Fixed capital	Working capital
: - - - Percent - - -					
1911-15:	100	100	100	100	100
1935-39:	145	189	162	73	71
1961-65:	201	312	197	85	63

Source: (13).

Growth of productivity on farms has improved the consumption levels of farm-people and permitted the net transfers of capital and labor from agriculture to

other sectors of the economy. Nearly one million people moved from farms to urban areas during 1950-65.

TECHNOLOGICAL INNOVATIONS

Technological innovations that increase output per hectare and per worker have made a significant contribution to agricultural progress in Taiwan. Emphasis has been placed on introducing plants and animals from abroad, including rice from Japan, sugarcane from Indonesia and Hawaii, and hogs and poultry from several countries. Such importations have contributed greatly to increased productivity, especially during the early 1900's.

While the transfer of agricultural technology from abroad has been substantial, adaptive research is

necessary to develop varieties and breeds suited to Taiwan's climate and soil conditions and to find ways of controlling local pests and diseases. Accordingly, agricultural research institutions have been established to carry out this function, and in more recent years, basic research as well.

Taiwan's systems for carrying out agricultural research, education, and extension work are well developed. Inputs for research are large in comparison with those in most developing countries. In 1963, there was a technical staff of nearly 1,100 in 34 agricultural research stations and institutes. About 70 percent were graduates of vocational agricultural schools and 30 percent were college graduates. Other public enterprises, such as the Taiwan Sugar Corporation, also have experiment stations. Altogether, there are about 400 college graduates engaged in agricultural research. This means that in 1963 there was one college-trained agricultural research worker for each 2,100 farmers and each \$2 million of agricultural production. Counting all research workers, there was one agricultural research worker for each 800 farmers and each \$650,000 of agricultural production.

Agricultural and home economics extension work is conducted primarily by vocational school graduates. In 1966, only 36 of about 1,200 extension workers at provincial, county, and township levels were college graduates. These numbers do not include those employed by the Taiwan Sugar Corporation and similar enterprises. At the local level, there was one extension worker for approximately each 800 farmers.

Although agricultural education, research, and extension work are carried out by separate administrative organ-

izations, this arrangement has apparently not limited their effectiveness.

All educational institutions, including those for agriculture, are under the direction of the Ministry of Education. In 1966, there were two agricultural colleges with an enrollment of 2,600, one 3-year agricultural institute with an enrollment of 521, and 41 vocational agricultural schools with an enrollment of 28,472. The Provincial Department of Agriculture and Forestry has major responsibility for agricultural research. Under its jurisdiction are an agricultural research institute, a livestock research institute, seven agricultural improvement stations, and other research stations. In addition, there are specialized research stations, such as the sugar research institute and the tobacco research institute, under the jurisdiction of public corporations. Nearly all of these educational and research institutes and organizations were established during Japanese administration, but their work has been expanded in recent years.

Agricultural extension work is carried out through provincial, country, and township farmers' associations under sponsorship of the Provincial Department of Agriculture and Forestry. There were 341 township or local farmers' associations in 1966. Farmers' associations are multipurpose and have three major sections: (1) an economic section for marketing farm products and purchasing farm supplies and consumption goods for sale to members, (2) a credit section for receiving savings deposits and making loans to members, and (3) an agricultural extension section for advisory and training services. Farmers' associations are the local organizational units through which Government agencies carry out programs with farmers. The Provincial Food Bureau, for example, through farmers'

associations carries out its fertilizer-barter operations, distributes pesticides and other supplies, and collects land taxes. The present federated system of farmers' associations has resulted from the amalgamation of many rural organizations formed in Taiwan since 1900.

Technological advances in crop production are shown by the following compound annual percentage growth rates in yields per hectare from 1911-15 to 1961-65: rice 1.8, sugarcane 2.8, sweet-potatoes 1.6, peanuts 1.8, pineapples 2.2, and citrus 1.9. It must be remembered that multiple cropping increased greatly, and cropping patterns have changed to include more of the high-value crops. Crop production per hectare of arable land has increased 3.5 percent a year since 1940.

A combination or package of improved farming practices is responsible for yield increases. It includes better crop varieties, increased use and timely application of chemical fertilizer and pesticides, rotational irrigation to maximize use of available water supplies, and better cultural practices with respect to spacing of plants and weed control.

Livestock productivity per animal unit has been increased by the introduction of improved breeds adapted for Taiwan conditions, better feeding practices, and increased attention to health and disease control. Feed rations have been improved to include more protein meals to achieve earlier maturity in hogs and higher rates of lay in poultry.

Agricultural research has been largely applied research focusing on practical problems of farmers. Field demonstrations of improved farming methods have been widely used. When it is demonstrated at the farm level that

new technology increases economic returns, farmers have readily adopted the new methods.

STRUCTURAL ORGANIZATION OF FARMING

Questions often are raised concerning what sizes of farms and systems of land tenure are most conducive to increases in agricultural productivity. Taiwan's experience indicates that small farms can be efficient in expanding agricultural output when local supporting services are built up to provide extension education, production requisites, credit, and marketing facilities. The fact that a large share of the farm operators were tenants or part owners apparently did not restrict expansion in agricultural output before World War II. However, land reform after 1945 increased the land area operated by owners, contributing to more intensive use of land and increased agricultural productivity.

Taiwan is a land of many small farms, averaging about 1 hectare in size. As farm population increased rapidly, especially after 1940, the number of farms increased but the average size decreased (table 39). The number of farms went up only 7 percent from 1912 to 1940, but doubled between 1940 and 1965. Farm population increased only 36 percent from 1912 to 1940, but it nearly doubled between 1940 and 1965 as population growth rates went up. Average farm size increased slightly from 1912 to 1940, when cultivated land area increased. However, average size decreased nearly 50 percent from 1940 to 1965. Agricultural output per farm was maintained despite the decrease in farm size.

Given the large increase in farm population, the only alternative to

Table 39.--Taiwan: Number of farms, cultivated land, land per farm, and agricultural output per farm and per hectare, selected years

Year	Number	Cultivated	Cultivated	Agricultural output	
	of farms	land	land per	Per farm	Per hectare
		Thousand	Hectares	Percent	Percent
1912	401	690	1.72	100	100
1940	430	860	2.00	216	186
1965	847	890	1.05	231	378

Source: .(13).

reduction in size of farms would have been larger farms with more families and workers per farm. A larger net migration of farmpeople to nonfarm occupations was not an effective alternative, as farmpeople migrated to cities to the extent employment opportunities were available. The breakup of farms into smaller units apparently improved incentives to use land more intensively, thus obtaining additional production from available labor.

Before land reform began in 1949, two-thirds of the farmers were tenants or part owners, and two-thirds of the fertile irrigated land was rented. Rental rates varied from 50 to 70 percent of the main crop. In addition, tenants often had to pay "key money" to obtain use of land. Land reform was carried out in three stages: (1) rent reduction and other improvements for tenants beginning in 1949; (2) the sale of public land to tenants, initiated on a large scale in 1952; and (3) the land-to-the-tiller program (under which tenants bought land which had been purchased by the Government from landlords) beginning in 1953. Under the rent reduction program, rents were reduced to 37.5 percent of the main crops and tenants obtained long-term leases. Under

the second and third stages (sale of Government land and the land-to-the-tiller program), tenants purchased land for the equivalent of 2.5 times the value of the annual crop yield. Payments were made in 20 semiannual installments over a 10-year period. The proportion of farmers owning all the land they operated increased from 36 percent in 1949 to 60 percent in 1957.

The land reform program did not involve the splitting up of large estates. Tenants who became owners were operating farmers, accustomed to making managerial decisions. The payments they made for purchase of land usually were smaller than the rent they had been paying.

Land reform had favorable effects on agricultural development. Tenants who became owners took an active part in local Government group organizations such as farmers' associations, irrigation associations, and cooperatives. While land reform could not solve the problem of increasing population pressure upon limited land resources, it enabled farmers to exercise greater control over their economic and social welfare.

LAND AND WATER DEVELOPMENT

The extreme scarcity of land resources in Taiwan has made it necessary to utilize arable land to grow crops the year around wherever possible. Taiwan as a whole has abundant rainfall, but it is unevenly distributed throughout the year. Heavy rainfall in hilly and mountainous areas provides potentials for irrigation of the lower level areas. But rapid runoff from torrential rains requires flood control measures.

Approximately 200,000 hectares had been developed for growing rice before the beginning of the Japanese occupation in 1895. Irrigated land area increased rapidly during Japanese rule, and by 1940 had increased to over 500,000 hectares (table 40). Although the total irrigated area has not increased much since 1940, improvements have been made in irrigation, flood control, and drainage structures. More abundant supplies of irrigation water have made possible increased multiple cropping. On the average, irrigated land now grows three crops a year.

Large investments for irrigation, flood control, and drainage were made

during the Japanese colonial period. The Government planned and constructed irrigation projects, with farmers paying only a small part of the costs through membership in irrigation associations. Irrigation was viewed by the Government as an infrastructure investment necessary for agricultural development, similar to investments in education, research, transportation, and communications.

The policy of supporting irrigation as an infrastructure investment was continued by the Chinese Government after 1945. Irrigated area decreased by half during World War II, due to destruction and lack of maintenance of irrigation structures. Rehabilitation of irrigation systems from damage caused by floods and wartime destruction was completed about 1955. Since then, many irrigation projects have been constructed to make fuller use of available water supplies and to provide flood control protection.

Relatively little mechanized equipment was used for irrigation and road improvements, especially during the 1920's and 1930's. Instead, the abundant rural labor supplies were utilized, thereby yielding large economic returns from resources that otherwise would have been idle much of the year.

Table 40.--Taiwan: Agricultural land use and irrigation, selected years

Year	Cultivated land			Total planted area	Multiple- cropping ratio
	Total	Irrigated	Dry land		
		paddy			
: - - - - - Thousand hectares - - - - - Percent					
1910	675	332	343	827	123
1940	860	529	331	1,366	159
1965	890	537	353	1,766	198

Source: (13).

A land consolidation and improvement program was initiated in 1961 to consolidate the many small plots operated by each farmer and to improve irrigation, drainage, and roads. Approximately 110,000 hectares have been consolidated and improved thus far. It is expected that 300,000 hectares will be improved by 1971 and 700,000 by 1980. In areas where programs have been carried out, they have increased crop production about 30 percent, reduced irrigation water needs up to 20 percent, improved opportunities for mechanization, increased effectiveness of pest control measures, reduced the area used for roads and paths to fields, and made fields more readily accessible. Once the benefits are demonstrated, farmers, who pay most of the costs, are receptive to land consolidation and improvement.

CAPITAL AND CREDIT

Agricultural development in Taiwan has required large amounts of capital for use in farm production, marketing, and supply industries. Total working capital inputs used in farming (including fertilizer, pesticides, feed, tools and equipment, and other materials) were six times greater in 1961-65 than in 1911-15. Fixed capital inputs for buildings, draft animals, livestock, poultry, and farm machinery were nearly five times as large. With rising expenditures and investments, farmers have required more credit to finance their farming operations.

Capital inputs accounted for 32 percent of all inputs used annually in farm production in 1961-65, compared with 23 percent in 1936-40 and 11 percent in 1911-15 (table 41). Farmers have become increasingly dependent upon purchases of fertilizer, pesticides, imported feed, seed, tools and equipment.

Table 41.--Taiwan: Percentage distribution of input categories in selected periods

Input	1911-15	1936-40	1961-65
	: 15	: 40	: 65
<u>Percent</u>			
Land	: 63	52	41
Labor	: 26	25	27
Capital, total	: 11	23	32
Fixed capital	: 9	19	27
Working capital	: 2	4	5
Farm produced	: 7	6	10
Purchased non-farm	: 4	17	22
	:		
Total	: 100	100	100
	:		

Source: (13).

Data for 600 recordkeeping farm families in 1965 showed expenditures per hectare of about \$120 for fertilizer, \$123 for feed, \$25 for equipment, and \$16 for pesticides and disease control. Purchased capital inputs accounted for only 4 percent of all inputs in 1911-15, compared with 17 percent in 1936-40 and 22 percent in 1961-65.

Large increases in purchased capital inputs were necessary to apply improved technology and increase output per hectare and per worker. Measured in constant prices, value of agricultural production increased \$8 for each \$1 increase in value of purchased capital input from 1911-15 to 1961-65. Of course, increased inputs of farm-produced capital, land, and labor also contributed to the growth in total agricultural output.

Use of capital inputs for mechanization to replace labor has generally not been economic in view of Taiwan's plentiful labor supply. But many improvements were made in machinery

and equipment for such jobs as threshing and drying grains. Also, the use of small tractors for field cultivation and transportation of farm products and supplies has increased in the last few years.

Farmers have relatively large investments in land, buildings, orchards, livestock, and farm machinery, although their farms are small. In 1965, for example, total assets per farm averaged about \$5,450 for the 600 recordkeeping households. Value of irrigated land averages about \$3,000 per hectare. Farmers do not have large debts. At the end of 1965, liabilities of the recordkeeping families averaged only about \$275 per farm, mostly for production credit.

Before 1950, private moneylenders, particularly landlords, supplied over 80 percent of the credit used by farmers. However, land reform brought about drastic changes in agricultural credit systems. Loans for agricultural activities are now made available through a number of agricultural credit institutions and Government agencies and enterprises. In 1965, these organizations supplied 65 percent of all agricultural loans and private moneylenders supplied the remainder. Credit institutions and Government agencies make loans to farmers' associations, irrigation associations, and marketing cooperatives as well as to individual farmers through farmers' associations.

Credit sections of farmers' associations now play a dominant role in rendering credit services to farmers. Borrowings from Government banks and agencies and savings deposits of farmer members provide funds for making loans. Specialists employed by extension sections of farmers' associations help farmers develop plans for productive use of loans. Interest rates to farmers average a little

over 1 percent a month, or 12 to 13 percent a year, but loans usually are for only a few months' duration.

FARM PRICES AND MARKETS

Favorable input-product price ratios provide economic incentives to expand farm production. Fully as important are assured market outlets for farm products at stable prices. During the Japanese colonial period, Japan provided export outlets for all the rice and sugar Taiwan could produce. Production of sugar for export to Japan was emphasized in the 1920's. Rice production for export was stressed in the 1930's and 1940's. Export markets in Japan also stimulated production of bananas, canned pineapple, and other products. Although prices to farmers were not high, they did not decline as output increased, due to export market demand.

Since 1950, Taiwan's domestic demand for farm products has increased at an annual rate of 5 percent or more each year. In addition, export markets continue to be important. Policies to diversify agricultural production and exports, including emphasis on exports of mushrooms, bananas, canned pineapple and asparagus, and other fruits and vegetables, have provided farmers with new market outlets in recent years.

Prices farmers receive for their farm products relative to prices they pay for capital inputs have averaged relatively low in Taiwan. (Prices paid for fertilizer are about a third higher in Taiwan than in Japan, Netherlands, and the United States.) Even so, price ratios between crop products and fertilizer and other capital inputs have been favorable enough to encourage use of fertilizer and other inputs.

But the major reason for increasing fertilizer use has been to achieve large production gains. More irrigation water and the introduction of new, improved crop varieties and pesticides have caused relatively high production response from fertilizer use. Farmers soon learned that adoption of packages of improved farming practices involving the use of additional capital inputs caused production to rise and net incomes to increase.

Facilities for marketing farm products and distributing farm production requisites are well developed in Taiwan. Railroads and highways provide good transportation facilities. Farmers do not have to travel far to reach local market centers. Township farmers' associations provide milling and storage facilities for rice and sell production requisites and consumer goods. They also market hogs, poultry, tobacco, peanuts, soybeans, and other crops. Fruit and vegetable marketing cooperatives provide transportation, processing, and selling services, and are directly engaged in exporting bananas, citrus fruit, canned fruit and vegetables, and other items.

The present marketing system has been built up over a long period. Some sugar refineries and railway lines were established in Taiwan before the Japanese occupation. But large investments to improve railway and highway transportation and farm marketing facilities were made under the Japanese. Many local cooperatives for marketing farm products and distributing farm supplies were also established. However, marketing facilities have been improved greatly in the last 20 years.

ECONOMIC GROWTH OF NON-AGRICULTURAL SECTORS

Rapid economic growth of nonagricultural sectors has contributed greatly

to Taiwan's agricultural development, especially since 1950. Demand for farm products in towns and cities increased rapidly because gross domestic real product and income of nonagricultural sectors increased at a compound annual rate of over 9 percent a year from 1951 to 1968 (12). Domestic markets for farm products became increasingly important relative to export markets. The share of total food production moved into export markets decreased from about 45 percent in 1935-39 to 12 percent in 1961-65. The share consumed domestically increased from 55 percent to 88 percent.

As per capita incomes increased, demand for animal products, fruits, and vegetables accelerated. Per capita food consumption measured in constant prices averaged about 40 percent higher in 1961-65 than in 1935-39. Taiwan has increased its imports of soybeans and feed grains for use in poultry and hog production in the last few years. Wheat imports have also risen.

Employment in nonagricultural sectors increased 4.5 percent a year from 1951 to 1968. Many farmpeople migrated to jobs in cities. Net migration from agriculture to nonagricultural sectors during 1951-68 was equal to about 15 percent of the nonagricultural population in 1968. Agriculture's share of total population decreased from 53 percent in 1951 to 45 percent in 1968. However, the nonagricultural sectors did not provide employment for all of the net growth in labor force and agricultural population.

The heavy emphasis placed on industrial growth did not limit expansion in agricultural output. In fact, it helped increase agricultural productivity by providing employment opportunities for many workers not needed in agriculture, fertilizer and other production requisites

required to increase crop yields, and expanding markets for farm products.

Taiwan's economy is becoming more like Japan's with rapid growth in manufacturing and related industries. Manufacturing output increased 15 percent a year from 1951 to 1968. Manufacturing accounted for 21 percent of net domestic product in 1968, compared with only 13 percent in 1951. Agriculture's share of net domestic product decreased from 36 percent in 1951 to 23 percent in 1968.

EXTERNAL ASSISTANCE AND INVESTMENTS

During the Japanese colonial period, Japan made large infrastructure investments for improving communications, transportation, sanitation, and health facilities. However, manufacturing industries were limited mainly to processing of agricultural products. Japan put high priority on improving agricultural technology and building up Taiwan as a source of low-cost agricultural products. More balanced economic development policies have been followed in Taiwan since 1950. Economic aid and private investments from the United States and other countries helped Taiwan achieve rapid economic growth during the 1950's and 1960's.

During the fiscal years 1951-65, U.S. economic aid obligations to Taiwan totaled \$1,465 million (52). Because a considerable amount of obligated but undelivered aid remained at mid-1965, when economic assistance except food aid ended, annual deliveries of aid averaged about \$80 million over the period 1951-68. Aid obligations amounted to over 10 percent of Taiwan's gross national product (GNP) in 1951, but declined to 2

percent of the greatly enlarged GNP in 1965. These amounts do not include additional food aid in 1966-68.

Sixty-three percent of the economic aid was for defense support to enable the country to maintain an agreed level of military strength and to maintain the military forces necessary to carry out mutual Chinese-U.S. objectives, without retrogressing economically. Approximately 24 percent was food aid; only 13 percent was classified as development aid. Development loans accounted for 10.6 percent of the total, and technical assistance for only 2.4 percent. However, the amount for defense support far exceeded that required to offset the military burden and did have developmental effects, according to Jacoby (52).

Taiwan's aid imports consisted of: (1) industrial materials for domestic processing, (2) capital goods, (3) human capital-knowledge skills and technology supplied by U.S. technicians and training of Chinese participants, and (4) imports of consumer goods. The breakdown of these resources inputs during 1951-65 was as follows:

	Million <u>dollars</u>	Percent
Industrial materials	883	60
Capital goods	367	25
Human capital	67	5
Consumer goods	<u>148</u>	10
Total	1,465	100

A large part of aid-financed commodity imports were "paid for" by the Chinese Government in New Taiwan (NT) dollars and deposited in segregated accounts under U.S. Government, Chinese Government, or joint control. U.S. dollars and aid-generated NT dollars complemented each other in financing

developmental projects (table 42). Of the \$1,092 million in total aid allocations to sectors of Taiwan's economy during 1951-65, 37 percent was to infrastructure, 22 percent to agriculture, 26 percent to human resources, and 15 percent to industry, including fertilizer and farm-related industries. Only 6 percent of all aid funds went into strictly private enterprises. About 27 percent went into mixed public and private ownership, or agencies that served both kinds of enterprises. Two-thirds was allocated to purely public enterprises or agencies.

During 1951-63, total U.S. capital assistance (both U.S. dollars and non-duplicating aid-generated NT dollars) amounted to about \$810 million, representing 31 percent of Taiwan's net domestic investment of \$2,605 million. Aid funds comprised 74 percent of all investment in infrastructure and 59 percent in agriculture, but only 18 percent of the total in human resources, and 13 percent in industry. Nearly half the \$2,605 million in net domestic investment in Taiwan during 1951-63 was made in industry. Private business accounted for most of the large investments in industry.

Jacoby has estimated that without aid GNP would have grown only 3.5

percent a year until 1983 (52). He concludes that aid more than doubled the annual rate of growth of Taiwan's GNP and quadrupled the annual growth of per capita GNP.

Taiwan made effective use of large amounts of agricultural commodity aid in its economic development programs. Agricultural commodity aid was used in a manner that did not interfere with economic incentives of farmers to increase agricultural output and productivity.

It also should be noted that a large part of the economic aid was devoted to agricultural development. Although U.S. capital assistance to agriculture accounted for only 22 percent of total capital assistance to Taiwan, it financed nearly 59 percent of net domestic capital formation in agriculture during 1951-65.

U.S. aid to agriculture was carried out through the Joint Sino-American Commission on Rural Reconstruction (JCRR). JCRR was highly successful in carrying out technical assistance as well as capital assistance projects in agriculture (61).

Table 42.--Taiwan: Allocations of U.S. economic aid by sectors of the economy, 1951-65

Sector	U.S. dollars	NT dollars	Total dollars	Distribution of total
: - - - - Million - - - -				
Infrastructure	235.9	171.1	407.0	37
Agriculture	56.1	179.0	235.1	22
Human resources	140.7	142.5	283.2	26
Industry	100.1	66.2	166.3	15
Total	532.8	558.8	1,091.6	100

Source: (52, p. 50).

FUTURE PROBLEMS AND OPPORTUNITIES

Population growth still is rapid and land resources are severely limited in Taiwan. Ways must be found to push agricultural productivity to even higher levels.

Changes in population growth rates in the next few years may have important effects on total food requirements and on the number of people dependent upon agriculture for employment. Birth rates have declined since 1955 as population planning programs have become more effective (fig. 20). But death rates also have gone down. It is anticipated that natural increase in population may decrease to about 1.8 percent by 1975.

If population increases 2.1 percent a year on the average from 1968 to 1975 and per capita income increases 5.2 percent and the income elasticity of demand for food is 0.4, food supplies will need to increase 4.2 percent a year to meet growing domestic demands. This rate is not much lower than that achieved in the 1950's and 1960's.

Growth in crop output will have to be achieved by increasing crop yields, additional multiple cropping, and shifts to more high-value crops since the land area under cultivation cannot be expanded. Growth in crop output will require better technology and more capital inputs.

Demand for livestock products, fruits, and vegetables will increase greatly if real per capita incomes rise 5 percent

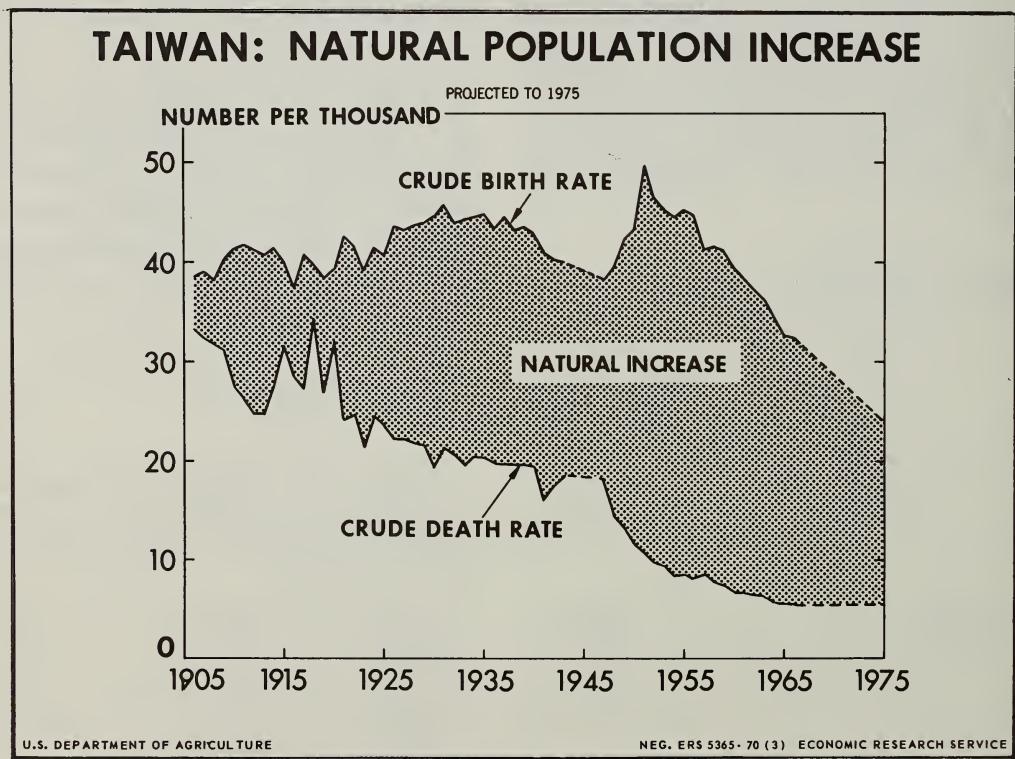


Figure 20

a year. Taiwan will need to import increasing amounts of feed grains and soybeans to expand output of animal products.

A declining rate of population growth would greatly affect the labor force in agriculture, sizes of farms, and mechanization. If the population growth rate declines to 1.8 percent in 1975, total population in agriculture may begin to decline. This would provide opportunities for expanding sizes of farms. Or, if farms do not change in size, it would permit a reduction in the number of workers per farm. Mechanization of farming operations and the average

productivity of farmworkers would increase. Incomes of farmpeople could rise more rapidly than in the past.

Taiwan's limited land resources pose questions about the role of agriculture in future economic development. Taiwan has about as much arable land per capita as the Netherlands and only slightly more than Japan. Taiwan's economy needs to become more like Japan and the Netherlands, using exports of industrial products to finance imports of agricultural raw materials. However, agricultural productivity must be increased wherever possible to maximize overall economic growth.

Chapter VII. MEXICO: ITS SOURCES OF INCREASED AGRICULTURAL OUTPUT

By Reed Hertford

Two features distinguish Mexican agricultural development. First, production increased over a long period of time at rates well above most other Latin American nations. From 1940 to 1965, gross farm output rose at a compound annual rate of 4.6 percent. During this period, diets improved, the balance of agricultural product exports over imports increased by more than 8 percent annually, and sales of farm commodities became the most important source of foreign exchange earnings. Since 1950, agricultural exports have accounted for 11 percent or more of total agricultural production.

Second, Mexican public policy has had a significant "bent for agriculture" (42). Since the mid-1930's, the Mexican Government has made exceptional commitments to improve both the levels of production and the distribution of agricultural production resources. Major public policies have involved large-scale irrigation projects and reform of the ownership of farmlands.

This chapter summarizes results of a larger econometric study of the rapid expansion in production and productivity in Mexico between 1950 and 1965. ^{6/} It also links irrigation and land reform developments to changes in the employment and returns of particular factors of production.

^{6/} Hertford, Reed. Sources of Change in Mexican Agricultural Production, 1940-65. Unpublished doctoral dissertation, Univ. of Chicago, Mar. 1970.

A PERSPECTIVE

Resource and Settlement Patterns

The southern part of Mexico's land area is in the torrid zone. Its patterns of land use and settlement resemble those of many other Latin American countries. Population has been concentrated in this area for centuries, massed primarily on the Central Mesa. Ample rains allow cultivation without irrigation; the growing season is long, and summers and winters are mild. Crop production is undertaken mostly in high flats and rich valleys. Farther south, on the Southern Mesa and Chiapas Highlands, the topography becomes rough, mountains and gorges are pronounced, and the extensive valleys and high plateaus of the Central Mesa are lacking. In limited areas suitable for agriculture, many farmers cultivate corn on badly eroded slopes, graze small herds of cattle, and cut timber from mountain forests. Life is rural, and agriculture continues for the most part in its traditional form.

In the northern half of the Republic, above the torrid zone, much of agriculture is located in the Sonora Desert, Lower California, and the western parts of the Northern Mesa. Over most of this region, annual rainfall is less than 20 inches a year. Unlike other areas in Mexico and much of Latin America, crop production is nearly impossible on these vast stretches of level land without irrigation. Hence, irrigation became a cornerstone of settlement. An additional factor was early and continued improvement in transportation, due in part to the area's

proximity to the United States and the desire to export minerals and selected crop and livestock products.

As elsewhere in Latin America, recent changes have occurred in Mexico's lowland tropics, including the Gulf Coastal Plain, the Isthmus of Tehuantepec, and the western extremes of the Southern Escarpment. Settlement has been somewhat less rapid, however, than in the north. Heavy rains, extreme heat, humidity, and high winds have been discouraging factors. Apart from settlement of Veracruz State and development of cotton production on the northern gulf coast, the most dynamic changes in Mexico's hot country have centered in oil-rich areas and port towns along the coastal belt of the Gulf of Mexico.

Public Policies in Agriculture

Since much of Mexico lies in the dry region, quality farmland is considered a "scarce" resource. Thus, major agricultural policies have been concerned with land. Irrigation developments improved the quantity and quality of available land; land reform was designed to insure its equitable distribution.

Public Irrigation.--The National Commission of Irrigation was created in 1926. Since 1947, the Secretariat of Water Resources (hereafter abbreviated "SRH") has developed and administered water projects. These agencies have carried out three basic programs: development of irrigation projects larger than 5,000 hectares; development of projects smaller than 5,000 hectares in extremely dry, less suitable areas; and rehabilitation of areas in which inadequate drainage led to waterlogging, soil deterioration, and high salinity.

Before 1926, Mexico had approximately 1.5 million hectares of privately irrigated cropland. This area has remained about constant, but in the past four decades the area irrigated under Government projects increased to well over 2 million hectares. Investments by the Mexican Government in irrigation have consistently exceeded by a substantial margin those made in any other single agricultural program (table 43). In fact, only transportation and communication projects have received larger amounts of public funds.

The impact of these investments in irrigation has been striking. Practically all the "transforming" of Mexican agriculture since 1940 has occurred in the districts operated by SRH. On irrigated land, Mexican farmers have used all the inputs associated with modern agriculture--improved seeds, fertilizers, insecticides, mechanical power, and implements. Outside SRH districts, such dramatic change is simply not in evidence. In 1960, crop yields per hectare in SRH districts averaged \$210, while outside they averaged only \$92. With about 12 percent of Mexico's harvested cropland, SRH districts annually produce one-third of the gross value of crop production.

Land Reform.--The legal basis for land reform is contained in Article 27 of the 1917 Constitution. It states, in part, that private farms of more than 500 acres may be expropriated. The land so taken can be granted to a group of 20 or more native-born Mexicans who live within 4 miles. Owners of large private farms may select and retain 500 acres. They have the legal right to compensation, but only a few have been paid; confiscation has been the rule. The recipients of expropriated land are called "ejidatarios," and as a rule have come from the laboring class of farm "campesinos." They are not given fee simple titles to land; they may

not mortgage, rent, or sell it. But they are permitted to work the land for life and transfer it on death to one rightful heir.

In a half-century of land reform, the well-known Latin American pattern of many private units of less than 5 hectares and a relatively few large farms that include most of the farmland has been broken by the emergence of ejidatarios (table 44). In 1930, well before major reforms, small private units ("mini-

fundios" of less than 5 hectares) and ejidatarios represented about 85 percent of Mexico's farm units, but had only 8 percent of all farmland (59, 1930). As of 1960, small private units held just 1 percent of all arable land and a relatively few large private farms worked over two-thirds of the land. But ejidatarios had acquired 29 percent of Mexico's arable land, 43 percent of the cropland, about half of publicly irrigated land, and 54 percent of all farm units.

Table 43.--Mexico: Investments in the public sector, 1935-63

Sector	1935-40	1941-46	1947-52	1953-68	1959-63
- - - - - <u>Percent</u> - - - - -					
Agricultural investments	<u>17.8</u>	<u>15.7</u>	<u>22.0</u>	<u>13.0</u>	<u>8.9</u>
Irrigation works	16.8	15.0	16.2	12.2	8.5
Other	1.0	.7	5.8	.8	.4
Industrial investments	<u>9.3</u>	<u>10.2</u>	<u>18.9</u>	<u>30.3</u>	<u>35.3</u>
Electricity	.7	2.2	6.8	6.7	17.3
Gas and oil	8.6	8.0	12.0	19.8	13.7
Other	---	---	.1	3.7	4.3
Communication and transportation investments	<u>51.4</u>	<u>51.6</u>	<u>40.2</u>	<u>36.3</u>	<u>30.2</u>
Roads	18.9	23.3	16.0	14.7	11.9
Railroads	29.4	26.0	21.3	16.0	11.4
Other	3.1	2.3	2.9	5.7	6.8
Social investments	<u>8.3</u>	<u>12.9</u>	<u>13.3</u>	<u>14.3</u>	<u>21.3</u>
Public housing	---	---	1.5	1.5	4.9
Hospitals	.7	1.5	1.5	1.5	4.8
School and research facilities	2.4	1.2	3.0	2.5	2.5
Other	5.2	10.2	7.3	8.7	9.1
Miscellaneous	<u>13.3</u>	<u>9.5</u>	<u>5.6</u>	<u>6.1</u>	<u>4.2</u>
- - - - - <u>Million pesos</u> - - - - -					
Total outlays	947	4,309	14,091	26,674	50,729

Source: (32, pp. 12-13).

Table 44.--Mexico: Comparative data on the structure of farming, 1960

Item	Unit	Private sector units			Ejido sector units	All farms
		Large 1/	Small 2/	All private		
<u>Basic data</u>						
Gross farm output	Mil. pesos	12,890	1,390	14,280	7,331	21,611
Crop output	Mil. pesos	7,703	823	8,525	5,870	14,396
Livestock output 3/	Mil. pesos	5,187	567	5,754	1,461	7,215
Arable land	1,000 bu.	71,660	1,295	72,955	29,943	102,898
Cropland	1,000 bu.	12,217	1,259	13,476	10,329	23,805
Pastureland	1,000 bu.	59,443	36	59,479	19,614	79,093
Workers	1,000	1,261	2,136	3,402	3,163	6,565
Family workers 4/	1,000	995	2,104	3,099	3,109	6,208
Full-time hired laborers 5/	1,000	271	32	303	54	357
Numbers of farm units	1,000	447	899	1,346	1,598	2,944
<u>Partial productivity measures</u>						
Output per farm	Pesos	28,836	1,546	10,609	4,588	7,341
Arable land per farm	Hectares	160	1	54	19	35
Workers per farm	Number	2.8	2.4	2.5	2.0	2.2
Output per hectare	Pesos	180	1,073	196	245	210
Crop output per hectare of cropland	Pesos	631	653	633	568	605
Output per farmworker	Pesos	10,222	651	4,197	2,318	3,292

1/ Over 5 hectares. 2/ .5 hectares or less. 3/ Excludes output "en poblaciones." 4/ Operators plus unpaid family workers. 5/ Adjusted for rates of employment. Note: Peso = \$0.08.

Ejidatarios produced about one-third of the value of gross farm output.

Compared with large private units, ejido farms are small. They produce one-seventh as much on about one-eighth as much land per farm, yet they employ three-fourths as many laborers per farm (table 44). Because production is weighted more heavily with crop items, however, total output per hectare of ejido land is generally higher, even though output per hectare of cropland in 1960 was somewhat lower than for large private farmers. Output per worker on ejido farms was only about \$160 the same year, although some ejidatarios had left agriculture, resulting in consolidation of land parcels over the years. Their exit from agriculture is indicated by the fact that 2 million ejidatarios were recorded as having "benefited" by land reform through 1960, while only 1.6 million were reported in the 1960 Census of Agriculture.^{7/}

Although these comparisons between ejidatarios and large private farmers do not uniformly favor the ejido structure, the data suggest that the ejidatario is better off than the small private farmer who has only a hectare of arable land, production of about \$120, and the same number of family members to feed and shelter. This inference is probably valid, even though many small private farmers earn income from sources outside agriculture, while ejidatarios generally do not.^{8/} Further, the net income^{9/} of \$180

^{7/} The data on numbers of ejidatarios benefited by land reform were derived from the various volumes of the *Memorias de Labores, Depto. de Asuntos Agrarios*.

^{8/} Most small, private farms are located on the outskirts of villages and urban centers. The farmer is generally a "part-time" farmer, as are his associated family workers. Ejidatarios, on the other hand, are found well outside urban areas, where part-time employment alternatives are more limited.

obtained by the average ejidatario in 1960 compares quite favorably with the \$85 earned by the average "peon," who was employed for only about 3 full-time months at \$28 a month.^{10/}

These comparisons indicate the "equity" of land reform: an ejidatario whose alternatives in agriculture might include working as a hired laborer, or perhaps operating a "minifundio," is better off as a result of land reform. Nonetheless, they do not answer the important economic question: Is the productivity of agricultural resources enhanced by their employment on ejido units?

Other Policies.--Secondary Government programs have complemented land reform and irrigation policies in practice. Seed improvement, fertilizer, and credit programs are closely related to irrigation developments. Rust-resistant, high-yielding wheats developed by a joint Rockefeller-Mexican research program are presently used entirely in irrigated regions. A byproduct of this research effort was its favorable impact on the number and competence of Mexican agronomists (81). Domestic fertilizer production and distribution have been supported by the Government corporation, GUANOMEX. While operating under some import protection, farm prices of chemical fertilizers have been set below production costs (42). Since 1952, when GUANOMEX was established, Mexican fertilizer consumption has increased about tenfold (from 31,000 to almost 300,000 metric tons of primary nutrients), the greatest share of this increase going to the Government irrigation districts. Credit programs of two official

^{9/} Net income is gross production less the implicit costs of using all inputs except land and family labor.

^{10/} Sources of Change in Mexican Agricultural Production, 1940-65. See footnote 6 for complete citation.

banks, BANGRICOLA and BANJIDAL, have supported purchases of these production requisites by private and ejido farmers. As of 1966, the reported value of the banks' outstanding short-term credit represented about 15 percent of the value of crop production.

In addition to these three programs, price support and crop insurance schemes stabilize prices and incomes of farmers for whom irrigation is not yet available. Improvement programs have attempted to upgrade productivity of livestock best suited to arid zones.

It would be inaccurate, however, to infer from this policy inventory that the Mexican agricultural development effort has "arrived," or achieved perfection. More resources could be devoted to agricultural research, as judged by Arditó's estimates of high returns to investment in wheat improvement (5, p. 36). Capitalizing costs and benefits (1943-62) at 20 percent per year, it was found that each peso invested in research yielded a social benefit of \$3.67 pesos. Also, almost half (48 percent) of the population over 14 years of age in rural areas is illiterate, while the comparable figure in urban areas is 21 percent. And, although significant new production possibilities have been devised for the irrigated areas of agriculture, little attention has been given to those without irrigation. The livestock sector, in particular, has been neglected.

The Mexican Approach

Yet, despite shortcomings, the agricultural development effort has achieved many of its objectives. An important reason for this success is the "Mexican Way" of handling policies. A significant aspect of this approach is strong motivation. The will to develop agriculture is

strengthened by major moral and political forces stemming from the Revolution of 1910:

One cannot study rural Mexico without running into the Mexican Revolution. It is encountered on every hand. It is spelled with a capital R and is regarded as a process which began in 1910. It is still going on. The first ten years were devoted largely to armed conflict or civil war. Since 1920 the Revolution has encompassed policies and programs designed to bring about the alleged ideals for which the armed conflict was supposedly fought. These are not stated precisely but appear to include such programs as land for the landless, books and schools for the illiterate, individual freedom from tyranny and oppression, and democracy in Government. (90, p. viii)

Another feature of the Mexican approach is that the Government has not constructed formal, comprehensive, and fully integrated development plans. Recognizing that good statistics are unavailable, that there was no standing army of technicians, and that organizational procedures were not highly sophisticated, Mexican officials used a rough-and-ready method to tackle their problems piecemeal. This imparted an uncommon flexibility to the conduct of specific development programs.

A third major element of the Mexican Way is that a substantial public investment of funds and other resources continued over a long period of years. Commitments to agriculture were not compromised by the also urgent demand for rapid industrialization.

A fourth feature has been a concentration of Government resources on a

limited number of programs, principally irrigation. An enviable percentage of projects completed in relation to projects planned reflects this concentration of effort.

Finally, it is noteworthy that Mexico has not undertaken to hold down the prices of food and other farm products as a means of combating inflationary pressures to which large development expenditures materially contributed. With the possible exception of milk production, essential economic incentives were preserved.

THE POST-1940 DEVELOPMENT RECORD

The Rockefeller Survey Commission of 1941--

found hunger in Mexico . . . the country (had) many of the aspects of an over-populated land. The level of subsistence was low; dietary standards were bad . . . Mexico was trying to support her people on 0.9 acres of cultivated land per capita . . . Mexico simply had too little farmland. The efficiency of crop production was low (81, p. 31-34).

In retrospect, it can be said that this statement was written at a significant turning point in Mexican agriculture. Most of the conditions it describes changed markedly in the post-1940 period (fig. 21).

Between 1940 and 1965, apparent food consumption increased 4.1 percent annually, or about 1.1 percent per capita. This permitted major improvements in Mexican diets. From 1934/38 to 1960, food consumption per person (in terms of calories) rose nearly 50 percent. This trend suggests that the caloric value of food use in Mexico may now be close to

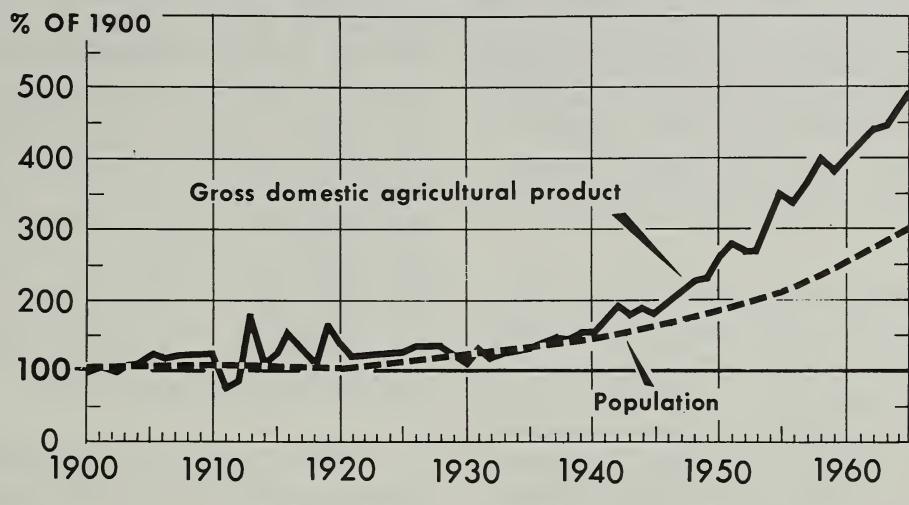
the average of about 3,000 calories consumed in high-income countries. Protein intake also increased from 53 grams daily per person to 67 grams. Wholesale prices of unprocessed food relative to nonfood and processed food products actually decreased over the time period, and foreign trade in agricultural products consistently yielded export surpluses (fig. 22). Principal exports were cotton, coffee, henequen (Mexican sisal), tomatoes, and live cattle. The United States was Mexico's primary customer. Coffee, cattle, meat, sugar, fruits (chiefly strawberries), and vegetables (mainly fresh tomatoes) made up about 80 percent of U.S. agricultural imports from Mexico.

The basic reason for these rapid increases in domestic food consumption and agricultural exports between 1940 and 1965 was an annual 4.6-percent expansion in gross farm output, which exceeded the 3-percent rise in population. Production rose sharply during World War II and has continued to increase at only slightly lower rates since then.

The record of performance in the crop sector was better and more consistent than in the dairy and meat sectors. From 1940 to 1953, total output of 37 principal crops increased almost 6 percent a year. It continued to increase nearly 5 percent after 1953. Nine crops (corn, cotton, coffee, beans, wheat, henequen, cane, tomatoes, and rice) accounted for 80 percent or more of the overall increase in crop production since 1940. Corn and cotton were the major contributors to this increase.

Aggregate output of dairy products also increased sharply in the earlier period, but remained almost unchanged between 1954 and 1965. In contrast, meat production (excluding poultry) rose moderately in the early period, but increased 5.3 percent a year from 1954 to 1965.

MEXICO: GROSS DOMESTIC AGRICULTURAL PRODUCT AND POPULATION



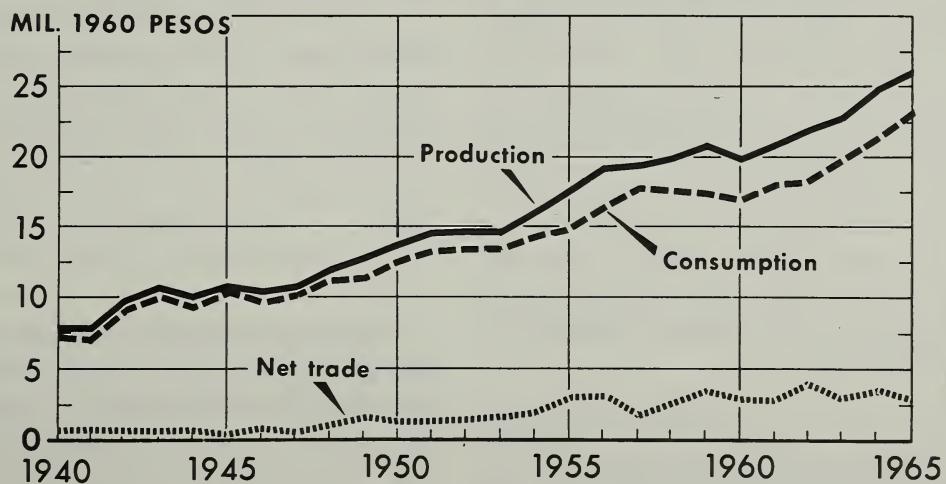
SOURCE: BANK OF MEXICO, DEPARTMENT OF ECONOMIC STUDIES.

U. S. DEPARTMENT OF AGRICULTURE

NEG. ERS 7456-70 (1) ECONOMIC RESEARCH SERVICE

Figure 21

MEXICO: PRODUCTION, CONSUMPTION, AND NET TRADE OF AGRICULTURAL PRODUCTS



SOURCE: MEXICAN AGRICULTURAL CENSUS OF 1940, 1950 AND 1960, AND ANNUAL DATA OF THE DIRECCION GENERAL DE ECONOMIA AGRICOLA.

U. S. DEPARTMENT OF AGRICULTURE

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Figure 22

SOURCES OF CHANGE IN PRODUCTION

Mexico's agricultural production grew rapidly between 1940 and 1965, as a result of changes in both the quantity and quality of productive resources. These resources include physical factors of production as well as "social inputs," such as land reform and irrigation development.

Compound rates of change in resources used were calculated from a time series of reasonably detailed inputs adjusted for changes in "quality". The inputs were grouped into six categories: purchased inputs (including fertilizers, insecticides, seeds, and irrigation water), family labor, hired labor, land, livestock capital, and power and implements.

These input variables may be summed to obtain a measure of total inputs, which in turn can be related to total output. In this way, output increases may be attributable to (1) increases in inputs, and to (2) increases in output per unit of input, i.e., gains in total factor productivity. The calculation is shown in table 45, where 1960 input shares are multiplied by the compound rate of change in inputs to determine the compound rate of contribution of each input. The sum of the input contributions equals total input. The difference between the rate of growth in total output and total input is called total factor productivity.

Total factor productivity increased at an average annual rate of 2 percent during the 25-year period 1940-65, with inputs rising at a 2.6-percent annual rate, and output advancing at a 4.6-percent annual rate. This is a strong productivity gain. The similar estimate for

U.S. agriculture during the same period was 1.5 percent average annual rate (60, p. 17). In the United States, total inputs showed only a small rise during the period, with the substitution of purchased inputs for human labor, so that the output per person employed showed a large rise. In Mexico, total inputs rose at a 2.6-percent annual rate, with all major inputs increasing. All labor increased at about 1.5 percent annually, with the most rapid advance in hired labor (4.8 percent) and smaller advances in the number of large farmers (2.2 percent) and ejidatarios (1.3 percent). For all the farm labor force, output per man increased at a 3-percent average annual rate.

Rapid increases occurred in purchased inputs (8.4 percent) and in power and implements (4.9 percent). Land increased at a 2-percent annual rate, and output per hectare rose at a faster rate (2.6 percent). As previously noted, agricultural output rose faster in the early part of the period, 1940-53, than in later years (1954-65). This was attributable to a reduction in the rate of increase of inputs from a 3-percent rate to a 1.8-percent rate between the two subperiods, with smaller increases in hired labor, land, and power and implements. Total factor productivity was a little higher in the latter part of the period than in the earlier years--rising from a 1.7-percent annual rate (1940-53) to a 1.9-percent annual rate (1954-65).

A cross-section comparison of 1960 Farm Census data from 1,500 counties was used to calculate production functions, applying the same classification of inputs. For this cross-sectional comparison, the productivity of purchased inputs, hired labor, and power and implements were all larger than their costs, and the productivity of land and family labor were lower. These cross-sectional results imply that

Table 45.--Mexico: Agricultural output, input, and total factor productivity, selected periods

Input	1960	Compound rates of change			Compound rates of contribution of total output		
	input	1940-53	1954-65	1940-65	1940-53	1954-65	1940-65
	factor						
	share						
	1/						
		<u>Percent</u>					
Purchased inputs		7.1	6.5	9.2	8.4	0.5	0.7
Hired labor		7.8	8.6	1.2	4.8	.7	.1
Farmers:							
Large		4.6	2.2	2.1	2.2	.1	.1
Small		6.2	.8	-1.1	-.1	---	-.1
Ejidatarios		11.0	2.4	.2	1.3	.3	-.1
Family labor		8.3	-1.4	1.1	-.1	-.1	-.1
Land		29.1	2.2	1.2	2.0	.6	.3
Livestock capital		19.0	1.9	1.9	2.4	.4	.4
Power and implements		6.9	6.7	2.4	4.9	.5	.2
Total input	100.0				3.0	1.8	2.6
Total factor productivity					1.7	1.9	2.0
Total output					4.7	3.7	4.6

1/ Percentage distribution of cost of factors in 1960.

Source: Hertford, Reed, Sources of Change in Mexican Agricultural Production 1940-65, unpublished doctoral dissertation, Univ. of Chicago, Mar., 1970.

most of the gains in total factor productivity could be explained by the estimated input weights from the aggregate production functions. 11/

UNDERSTANDING INPUT CHANGES

Purchased Inputs

The rapid increase in the use of purchased inputs and their high productivity--and therefore their large contributions to the growth of Mexican agricultural production in the post-1940 period--are

11/ These and other results are discussed in Sources of Change in Mexican Agricultural Production, 1940-65. See footnote 6.

closely tied to public irrigation developments. Because irrigation technology is distinct from dryland technology, especially under semiarid conditions, production under irrigation requires more intensive utilization of purchased inputs. Hence, as irrigation became available, a shift was induced in the demand for fertilizers, improved seeds, insecticides, and, to some extent, power and implements. This shift in input demand was dependent on the package of irrigation technology paying off. It did, handsomely.

Inside SRH districts, adoption of irrigation technology was aided by lower relative prices of purchased inputs. Sales costs for both private and public input suppliers were lower, since density of markets is high. Farms in these districts are concentrated in well-defined areas, accessible to all forms of transportation. Local experiment stations and extension and SRH agents promote adoption on new technology within the districts. Farms are flat, well tilled, and free of rocks or other debris. This quality of the land surface, as well as the more homogeneous soils, weather, and climatic conditions, reduces the number of input adaptations required to adopt irrigation technology on a large scale.

Outside the SRH districts, on the other hand, input costs are higher. Farms are small, located on precipitous mountain slopes, and relatively inaccessible. Communication and transportation systems are inefficient. Agents of change are scarce. Altitudes, soils, and climatic conditions vary greatly over short distances, and farm enterprises are geographically dispersed. Basic agronomic and economic data are lacking; potential sales volume is limited. Thus, the costs of supplying purchased inputs are higher and the assurance of profitable results are lower.

How much of the increase in purchased inputs is really attributable to this interaction of prices and technology? What would the increase in purchased inputs have been in the absence of SRH irrigation development? An answer can be suggested by reference to events of the 1954-65 period. During those years, data developed by this study indicate that there was little change in the ratio of prices paid by farmers for purchased inputs to prices received for 37 principal crops. The data also show that crop production outside SRH districts was probably increasing at less than 3.5 percent a year. Thus, it is reasonable to conclude that demand for purchased inputs--in the absence of irrigation--would have increased by about 3.5 percent a year after 1954. The fact was, however, that the recorded expansion in purchased input employment averaged 9.2 percent annually between 1954 and 1965 (table 45). The difference between these two rates gives an indication of the value of public irrigation developments to the growth performance of Mexican agriculture.

Labor

Many attributes of the labor input in Mexican agriculture are somewhat unique among the developing nations.

Mexico's rate of population growth has been increasing and is presently among the highest in Latin America. Although death rates have been reduced by improved levels of income and living, birth rates have remained unchanged. Population rose 2.8 percent a year in the 1940's, 3.1 percent during the 1950's, and all indications point to a rate in excess of 3.2 percent a year in the 1960's. Rates of rural outmigration have been high and increasing, holding population growth in rural areas relatively constant at 1.5 percent a year. Yet, farm output per

worker in agriculture (\$250) is lower than in any other Latin American nation for which comparable data are available (60). Thus, with about half the labor force, agriculture's share of gross domestic product is slightly less than 18 percent.

Labor is definitely not a homogeneous factor of production in agriculture: different kinds of labor have evidenced different returns and different rates of change over time. Hired labor, for example, increased rapidly and made large contributions to the growth in farm output after 1940, while family labor input increased slowly and made negligible contributions. Productivity of family labor, on the average, appears to be much lower than that of hired labor.

The structure of production resources in the ejido sector following land reform reduced labor's return. The estimated production functions show that the marginal increment to output associated with the family labor input of the ejido sector was extremely low in relation to the full-time wage rate of hired laborers. There are several reasons for the ejido's lower rate of return. The average-sized parcel granted ejidatarios through land reform was much smaller than the average size of private sector farms. There are either too many ejidatarios or there is not enough land to employ them profitably. Although the number of ejidatarios has declined and the size of the average ejido parcel has increased, neither of these adjustments has been carried far enough to materially change the economic imbalance. The reasons for this failure to adjust are not hard to understand. Employment opportunities for family labor on nearby farms are limited. Neighboring farmers are themselves ejidatarios, generally seeking to adjust their labor

input downwards--not upwards. The old haciendas expropriated under land reform were isolated, self-sustaining villages, and the ejido village has retained this character. Thus, employment is limited to specialized crafts and trades even outside agriculture. Packinghouses, warehouses, processing plants, and the like are in major cities some distance away from the village. Further aggravating labor adjustments is the apparent inability of ejidatarios to avail themselves of off-farm employment opportunities which do exist. The number of years of schooling completed by ejidatarios is only half that of private farmers and thus far below Mexico's low rural average.

Legal limitations on rental or sale of ejido land have been even more restrictive. Ejidatarios are not permitted by law to mortgage their land, except to one official agricultural bank, BANJIDAL. These nonalienation provisions give the ejidatario a questionable choice. He can remain in agriculture, obtaining low returns to the family labor input. Or he can forfeit his land without compensation, foregoing income corresponding to a rent on the net discounted future returns to the land input.

Land

Land is the most important capital input in Mexican agriculture, representing well over half the value of all physical capital. Although most farmland is devoted to pasture, the largest investment is represented by cropland (72 percent). Ownership is about evenly divided between the private and ejido sectors.

Little of the increase in cropland harvested came from reductions in the idle cropland or from reductions in crop failures. In each of the three most recent

censuses of agriculture, between 42 and 46 percent of cropland has been temporarily withdrawn from cultivation for rotation or fallow. Similarly, the percentage of cropland planted, but lost to diseases, droughts, frosts, or other weather factors, has been rather constant--14 percent in 1940 and 13 percent in both 1950 and 1960. Thus, the principal increases in cropland harvested came from multiple cropping, opening of new land through irrigation, and pasture conversion.

Multiple cropping is a relatively new development in Mexico. It affects only a small fraction of cropland harvested. Largest increases in multiple cropping came in areas with seasonal underemployment of labor, few off-farm employment opportunities, and good year-round weather. Some increases were also associated with the irrigated regions, but they were not a significant proportion of the whole.

Private farmers undertook most of the expansion of pastureland and its conversion to crop production. Ejidatarios acquired less than 400,000 hectares by means other than land reform since 1940, and part of the land they were granted was abandoned.

Private farmers who expanded their land input apparently reaped handsome rewards. The price per unit of all farmland increased at the annual rate of 21.1 percent a year in the 1940's and 7.3 percent thereafter. A rising average product of land reinforced this effect. Real output per unit of quality-adjusted farmland in 1940 was \$313 (1960) pesos.^{12/} By 1950 it had risen to \$426 pesos, and by 1965,

^{12/} The adjustment for "quality" basically involved reducing pastureland to a cropland equivalent basis, using the ratio of prices of pasture to unirrigated cropland as the conversion factor.

to \$625 pesos. Most of the increases came from the crop sector.

Livestock Capital

Mexico's cattle, pigs, sheep, and goats are concentrated in the Northern and Central Mesa areas. Cattle represented about 85 percent of the value of livestock in 1960. Pigs, sheep, and goats were of minor importance.

Cattle production traditionally has been divided according to the two markets it serves. In the north, because of poor pastures, constant threat of drought, and proximity to the U.S. border, cattle are produced almost exclusively for export to the United States as feeders and stockers. These animals weigh about 450 pounds and are 8 to 12 months of age at the time of shipment. Prior to shipment they are fed entirely on natural pastures. Few resources are committed for ensilage and hay production. Average pasture quality is poor, often consisting of only yucca tops and mesquite beans. Range capacity in normal years is between 5 and 50 hectares per animal, and the typical livestock enterprise is land extensive. This leads to inadequate herd control. Coupled with disperse water points, little fencing, and few corrals, these factors give rise to low calving rates the year-round and high mortality. Drought is the biggest killer.

Farther south, livestock enterprises are generally smaller and less subject to weather conditions. Some meat animals and most dairy cattle are fed alfalfa, other legumes, green forage corn, and sorghum. Concentrate feeding is limited, since most grains (about 85 percent) are fed to poultry. Milk production per dairy cow averages only 350 liters (740 pounds) a year. Some good quality cows are found near the Federal District, but

they represent only a fifth of dairy animals in that milkshed. Beef cattle are also mainly of mixed breeds. Apart from quality Hereford stock on the Northern Mesa and sturdy, tick-resistant Cebu in tropical areas, "corriente" or "criolla" breeds are the rule throughout Mexico. Efforts to improve the poor quality of Mexico's livestock herd have been limited.

The comparatively poor performance of the livestock sector has been the result of an array of special and sometimes unfortunate factors. The seemingly indifferent attitude of the Mexican Government toward livestock production reflects the association of livestock enterprises with the great "hacienda," the fact that meat, milk, and eggs are not staples of the Mexican diet, and recognition of limited possibilities for increasing meat production on the small plots given ejidatarios under land reform.

Land reform has also inhibited growth of the livestock sector in other ways. The legal definition of "affectable livestock land" which can be expropriated is subject to judgment. The Agrarian Code exempts private owners of pasture from expropriation if they own "no more land than is needed to graze 500 cattle." This limits the size of livestock enterprises and reduces incentives to make grazing land more productive. There are other areas of uncertainty, such as invasions of pasture by "squatters."

Power and Implements

Although Mexico ranks high among developing countries in the mechanization of agriculture, it lags far behind Western Europe and the United States. Less than a third of Mexican cropland is worked by mechanical power. Work animals continue to be an important source of farm power.

In 1960, they were used on three-quarters of all cropland. Most fully mechanized farms are located in the northern half of the Republic.

There are several explanations for the regional concentration of mechanical power in Mexico. The south has rough topography, smaller farms, poor roads, and inadequate machinery repair and maintenance facilities. Also, the northern frontier areas of Mexico have for years been engaged in land clearing, reclamation, transportation, and irrigation projects. Tractors and related implements have been important in these activities. As projects were terminated, heavy equipment often became available to farmers.

With the exception of threshers, most categories of machinery (including tractors, seeders, harvesters, and shellers) increased sharply during the period of most rapid expansion of irrigated cropland (1940-53). The effective stock of tractors doubled almost every 5 years, and the composite stock of seeders, harvesters, and shellers doubled five times. The 13.4-percent annual increase in the stock of all machinery between 1940 and 1953 made this input one of the most rapidly growing factors of production in Mexican agriculture.

The overall production contribution of the power-implement package was less spectacular than expected on the basis of early, high rates of growth. First, the rate of addition of new machinery tapered off, and second, the investment in work animals was large. Thus, with the number of work animals increasing only 2.4 percent per year between 1940 and 1953 and actually declining after 1950, the total effective stock of power and implements, including work animals, grew 6.7 percent a year between 1940 and 1953 and only 2.4 percent a year afterward.

CONCLUSIONS

Mexico's rapid expansion of agricultural production between 1940 and 1965 can be attributed about equally to increased employment of purchased inputs, hired labor, land, and livestock capital. Use of power and implements contributed also to overall growth but to a lesser extent than the other inputs.

Public irrigation developments in the north provided farmers with a profitable new technology. Lower relative costs of supplying purchased inputs in these intensive farming areas and the complementary benefits of their use sped adoption of the entire package of inputs associated with modern agriculture.

Increased use of family labor made a minimal contribution to output and average production per worker. The small size of the average ejido parcel, and obstacles placed on adjustment of the land-man ratio stemming from credit restrictions, limited opportunities for off-farm work,

low levels of schooling, and the non-alienation provisions of the Agrarian Code held down labor productivity.

However, any assessment of the effects of Mexican land reform must distinguish between its economic and equity benefits. Although returns to ejido family labor were low, the ejidatario made more net income than either small private farmers or hired laborers.

Despite the problems remaining, the Mexican Government's management of agricultural policies was a major positive force in the post-1940 development period. The large public investments in irrigation--coupled with policies for agricultural credit, fertilizer distribution, and agricultural research--made very direct contributions to the growth of production. The Government's commitment of resources for long periods of time, focus on a few major programs, and maintenance of basic economic incentives for farmers were also important factors in developing a favorable climate for the growth of Mexican agricultural production.

Chapter VIII. COLOMBIA: TRADITIONAL AND CHANGING AGRICULTURE

By L. Jay Atkinson

Agricultural output in Colombia increased at an average annual rate of 3.3 percent from 1950 to 1967, or at about the same rate as population. Despite great changes in economic and political conditions and significant shifts in output of various farm products during this period, the expansion in total agricultural output was rather steady with no apparent tendency to accelerate or to slacken (fig. 23). Output per capita showed only minor variations throughout the period.

Food production for domestic consumption expanded nearly as rapidly as total agricultural production, and thus about kept pace with growth in population. Although year-to-year variations were considerable, sometimes reaching 5 percent, no discernible trend developed (fig. 24). In 1966 and 1967, food output per capita was below the average for the 18-year period, but in the preceding 2 years it was above average.

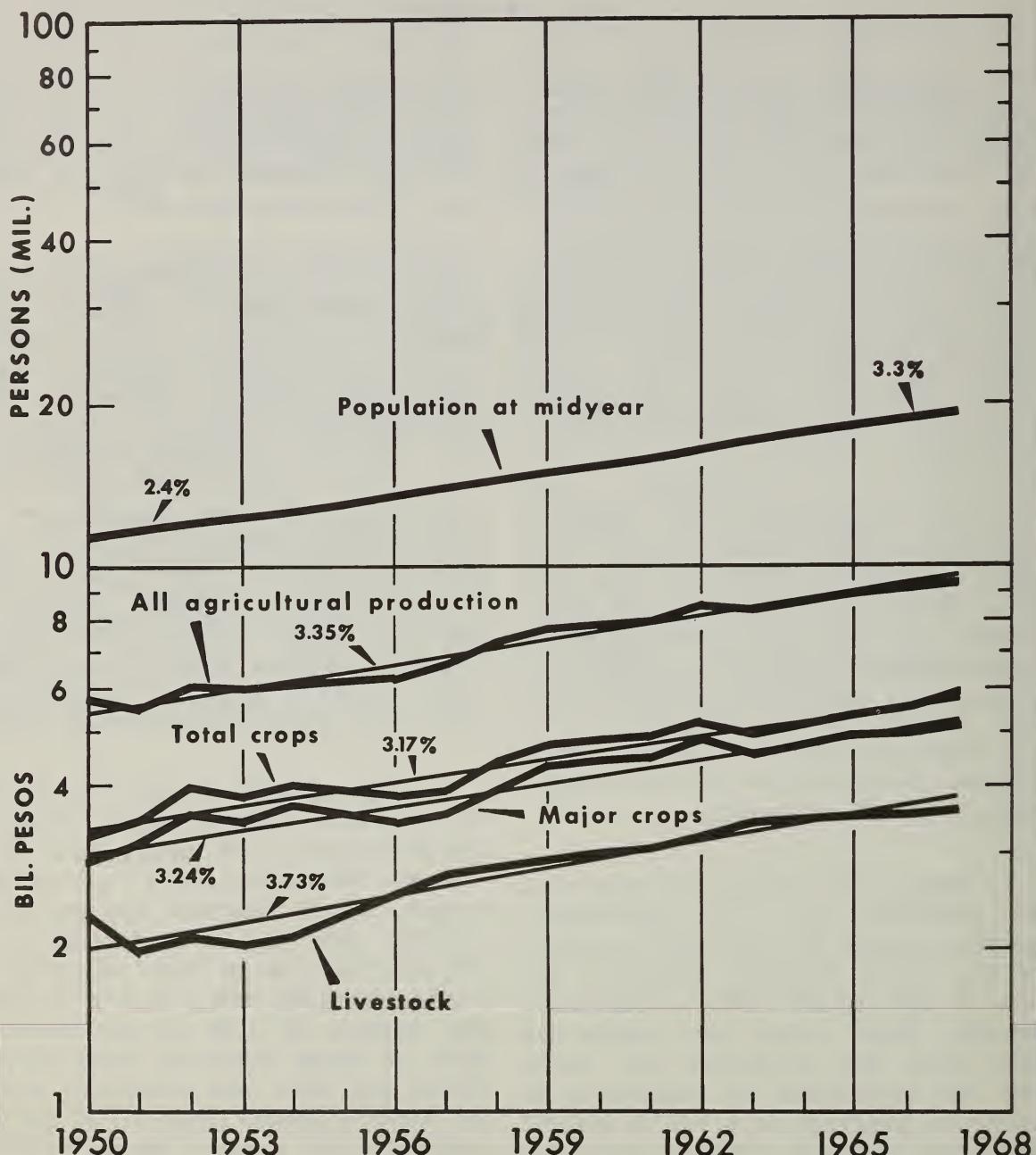
Food and agricultural production in Colombia is in an intermediate position among the developing countries of the world. Although Colombia has one of the highest rates of population growth, food output per capita has kept pace. But production per capita has not contributed as importantly to economic progress as it has in several developing countries. Periodic nutritional surveys have shown that on the average calorie consumption is somewhat low, and consumption of animal protein is considerably below recommended nutritional standards. Consumption is substantially below average for those with

low incomes in both rural and urban areas. Since real income per capita has shown a small advance in recent years, per capita demand for food and other farm products has risen slowly.

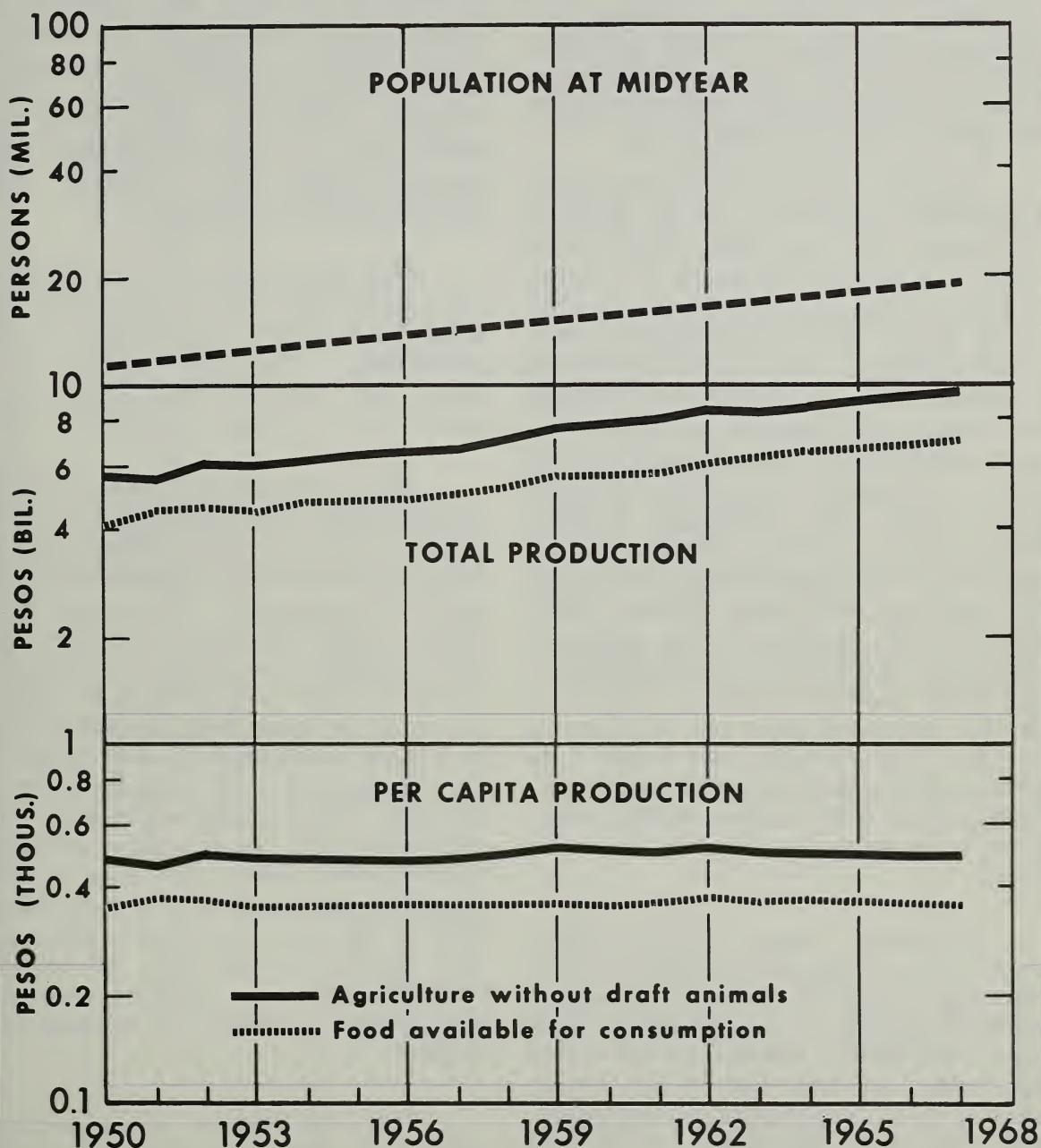
The rather steady expansion in agricultural production since 1950 is a combination of somewhat irregular changes for crops and livestock products. In the early years, 1950-55, declining cattle production was offset by expansion in other products, resulting in stationary output of all livestock and livestock products. About 1955, production of livestock and livestock products recovered, expanded strongly for several years, and then decelerated somewhat. Throughout the whole period, output of livestock and livestock products rose at an average annual rate of around 3.7 percent--a little above the rate of population increase.

Crop production has been subject to somewhat greater swings, which in the early part of the period lasted 3 or 4 years. Throughout 1950-67, the average annual rate of increase was about 3.2 percent. This was a combination of an increase in area in crops of about 1.8 percent annually, and a growth in output per hectare of 1.35 percent annually. Both of these advances were uneven. Output per acre was essentially stable for about a decade (1948-57) at the beginning of the period. During 1959-66, it advanced quickly to another plateau nearly one-fifth higher, before advancing strongly again in 1967-68. In 1969, crop output per acre apparently remained near the 1968 level, according to preliminary reports.

COLOMBIA: VALUE OF AGRICULTURAL PRODUCTION IN CONSTANT 1958 PRICES AND TOTAL POPULATION



COLOMBIA: TOTAL AND PER CAPITA VALUE OF AGRICULTURAL PRODUCTION IN CONSTANT 1958 PRICES, AND POPULATION



CHANGES BY CROP CATEGORIES

The diverse changes in Colombian crop production and technology are best understood if the crops are classified into groups. A summary of these groups is shown in table 46, but the following discussion is based on information throughout the period 1948-50 to 1966-68 (6).

Because coffee is so important in Colombian agriculture and so different in culture from all other crops, it is shown separately as Group 1. Coffee accounts for nearly one-third of the value of all crops, and three-fifths of the value of all exports. Most coffee is produced by small farmers using largely traditional technology. Yet farmers growing coffee are conspicuously more productive and more prosperous than farmers growing other crops with traditional methods. Some coffee growers cultivate an improved high-yielding variety (caturra) that is fertilized and grown without shade. Many of the functions of the coffee industry are handled by the well-organized, pervasive Coffee Federation. Coffee production increased about one-third during the past two decades, with most of the rise occurring in the late 1950's, following high prices a few years earlier which stimulated increased planting of coffee trees.

Plantains, panela (noncentrifugal sugar), yuca (cassava), and beans are the traditional crops of Group 2. They are grown principally by small farmers using hand cultivation. Production is a little less than one-fifth that of all crops. Area in these crops has increased slowly, and yields have been static. Production per capita has declined. As farmers have migrated to cities where all food must be purchased, they have switched from yuca and plantains to rice and wheat, and from panela to refined sugar.

Group 3--corn, potatoes, tobacco, and wheat--accounts for about 15 percent of total crop production. These crops are grown by small farmers using largely traditional practices, but they are also grown by large-scale commercial farmers using tractors and varying degrees of modern technology. Yields increased substantially during the early part of the period, and in 1966-68 averaged about one-third higher than in 1948-50. Crop area showed little expansion.

Plantation-type tree crops--bananas and cocoa--make up Group 4. They constitute only about 5 percent of crop production. The small area of these crops has expanded gradually, accompanied by a strong uptrend in yield.

Group 5 consists of three important crops--cotton, rice, and sugarcane. The latter is grown for centrifugal sugar, as distinct from cane for production of panela, which is in Group 2. Barley and three minor crops--sesame, soybeans, and grain sorghum--were placed in Group 5A. Group 5 crops now account for around one-third of total crop production, but they have contributed more than half the increase in crop output during the past two decades. All are grown by commercial farmers using tractors and other nontraditional inputs. The area in these crops has approximately doubled during each of the past two decades, and yields have increased more than 50 percent. Most of the land in Group 5 crops has never been cultivated by traditional hand methods.

Thus, the principal yield increases were in the crop groups in which relatively modern technology has been adopted--Group 5 (cotton, rice, and cane for refined sugar), Group 5A (barley, soybeans, grain sorghum, and sesame-seed), and in the limited acreage of Group

Table 46.--Colombia: Changes in acreage, yield, and production by major crop groups, 1948-50
average to 1966-68 average

Item	Unit	Traditional			Mixed technology			Plantation: type, tree technology			Relatively modern		
		Group 1:		Group 2	Group 3		Group 4		Group 5		Group 5A		All
		Yuca, beans	Corn, potatoes	Cotton, tobacco	Bananas, panela	cocoa	wheat	rice, barley, sorghum	Cotton, sesame, soybeans	rice, barley, sorghum	sugarcane	rice, barley, sorghum	soybeans, cotton, sesame, panela, tobacco, yuca, beans
1948-50 average:													
Area	1,000 hectares	634	569	918	74	191	52	2,437					
Yield	1/ Pesos	1,983	1,348	605	1,711	1,523	669	1,246					
Production	Million pesos	1,254	767	565	126	291	35	3,039					
1966-68 average:													
Area	1,000 hectares	813	679	995	96	577	188	3,347					
Yield	Pesos	2,034	1,354	811	2,689	2,539	1,014	1,580					
Production	Million pesos	1,653	919	806	258	1,459	190	5,286					
Percentage change, 1948-50 to 1966-68:													
Area	Percent	28	19	8	31	202	261	37					
Yield	Percent	3	0.4	34	57	67	52	27					
Production	Percent	32	20	43	105	401	438	74					

4's plantation-type tree crops (bananas and cocoa). Coffee yield per hectare showed no definite trend throughout the period, although it was appreciably higher during the 1960's than in the 1950's. The crops of mixed technology, Group 3, showed good increases for wheat and tobacco and smaller advances for corn and potatoes. The crops of Group 2 (plantains, cane for panela, yuca, and beans) showed no appreciable trend in yields during the period.

LIVESTOCK AND LIVE- STOCK PRODUCTS

Production of livestock and livestock products has expanded at a slightly faster rate than crop production during the past two decades, but has tapered off in recent years. The average rate represents relatively rapid growth for milk, poultry, and eggs, and rather slow expansion for other animal products--beef, pork, mutton, and wool.

Milk production increased at a rate fractionally above that of population during the period 1950-67. At the beginning of the period and in the last 5 years, production about kept pace with population growth.

Near the large cities, there are some modern dairy farms. Only a few use feed concentrates, since the price of feed is high and the returns from milk are low. Dependence on pasture for almost all feed for dairy cows--there is little silage and less hay--results in serious seasonal variation in milk production, with a shortage in the months of low rainfall.

In both poultry and egg production, modern technology has recently been introduced and is contributing a growing proportion of total output. As might be expected, poultry flocks tend to be of two

contrasting types, the traditional small farm flocks--15 to 20 hens--and the modern broiler and egg installations of several thousand birds. Output of poultry and eggs was stationary in the first half of the period under review. Production has expanded each year since 1958, not quite doubling in the 9 years up to 1967.

Hog slaughter increased moderately during the first part of the period, reaching a peak in 1961.

Mutton production is quite small and stable. Improved sheep breeds are being imported to graze the little utilized high Andean meadows. Native breeds of sheep (criolla) do not produce apparel grade wool, only carpet grade.

Beef is the primary meat produced in Colombia. Cattle ranches occupy three-fourths of the agricultural land, including much of the potentially productive area, as well as the least productive and most remote regions.

Cattle slaughter has not kept pace with population during the past two decades. Possibilities for expanding beef exports have been assessed as favorable, and various plans for expansion have been announced. Credit has been rather freely available, with special domestic funds supplemented by international loans. It is too early to ascertain the success of the recent expansion effort. In recent years, cattle slaughter has not shown much change. Since cattle numbers are reported to be increasing, it is probable that breeding herds are being built up.

Preliminary results from a survey of cattle ranches indicate that the level of technology is low, even in the areas with better ranches. Few ranches, except those specializing in purebred cattle for

breeding, are using recommended improved practices. Consequently, there is little evidence to show the profitability of improved practices under Colombian conditions. However, superior technology has been adopted in countries with similar climatic conditions. Livestock specialists believe that Colombian ranches could be more productive and profitable if improved technology were used. James E. Grunig reports that in the past attempts to adopt improved practices on livestock ranches did not always bring anticipated increases in production and were not generally profitable.^{13/} In any case, considerable expansion is necessary if Colombia is to meet announced export targets.

NONTRADITIONAL INPUTS IN AGRICULTURE

One valuable method of viewing progress in agriculture is to survey the extent to which improved practices, tools, and supplies have been adopted. Since World War II, Colombian agriculture has made substantial progress in the adoption of non-traditional inputs. Since the modernization process was just beginning in 1950, the period of this review covers the principal developments that have taken place up to 1968.

Improved Seeds

The Colombian Government showed an early interest in improved seed.^{14/} The principal responsibility for selection, multiplication, and distribution of seeds

was entrusted to the National Agricultural Bank (Caja Agraria), with participation by private enterprise and quasi-public commodity organizations. Production reached significant proportions as early as 1953. Basic scientific work of distinguished quality for the development of domestic varieties was done by the National Experiment Station, with several scientists from the Rockefeller Foundation playing an important and continuing role.

By 1967, 610,000 hectares in 11 crops were planted with improved seed--slightly more than one-third of the area in these crops and about one-sixth of the total for all crops cultivated. Over half the area planted to five of these 11 crops utilized improved seed in recent years. All the tobacco and cotton acreage was planted with improved seed from 1963 through 1967. For barley, soybeans, and grain sorghum, the proportion varied from 60 percent to nearly 100 percent. All of these crops (except tobacco) were grown with relatively modern technology and had yields that were well above average for developing countries. Production of each increased sharply during the past two decades.

For barley and tobacco, the improved seeds were developed within the country; the other crops utilized seed improved abroad and multiplied within the country.

In 1963, one-fourth of the area in irrigated rice was planted with improved seed; by 1967, the proportion exceeded one-half. All the seed was from imported varieties multiplied in the country. No improved seed was distributed for unirrigated rice.

Improved varieties of wheat were developed in Colombia rather early, and by 1959, were grown on nearly one-fifth of the acreage planted. After showing

^{13/} Grunig, James E. *Information, Entrepreneurship, and Economic Development: A Study of the Decision Making Processes of Colombian Latifundistas*. Land Tenure Center, Univ. of Wisconsin, Madison, 1968 (unpublished).

^{14/} See (20). This section is based upon a 1968 analysis by the National Planning Department.

little change for several years, use of improved varieties began to rise in 1965, reaching more than half the reduced acreage seeded in 1967. These did not include the new high-yield varieties.

Improved varieties of the remaining four crops were not widely planted. The proportion of improved corn planted varied from 10 to 15 percent of the total in 1962-66 but expanded to 23 percent in 1967. Only 10 percent of beans were planted with improved varieties in 1967, and better seeds for cocoa and potatoes were not widely distributed. An intensive effort to develop improved varieties of potatoes was sustained over a long period of years for this important crop, but encountered numerous and intractable problems of diseases, pests, and fungi as well as consumer resistance to the taste of new varieties.

The substitution of improved varieties for common ones has proved to be a complex and difficult undertaking. The substantial effort of the Government encountered numerous bottlenecks in development, multiplication, and distribution.

Pesticides--Insecticides, Fungicides, and Weedkillers

The volume of pesticides used averaged somewhat above 10,000 tons annually during 1951-67, with no definite trend discernible. None of the active ingredients were produced domestically, and only a small proportion were mixed within the country. Imports have shown wide year-to-year fluctuations, reflecting variations in controls imposed by the availability of foreign exchange. Nevertheless, the wholesale price of pesticides has risen less than the average of all wholesale prices during the past 10 or 15 years. Nearly 1 million hectares were treated with pesticides in recent years.

This is about one-fourth the total crop acreage, and considerably larger than the area fertilized.

In recent years, herbicides have formed an important part of the value of total pesticides, varying from 30 to 45 percent. Most of the remainder consisted of insecticides, with fungicides a small fraction of the total.

It has not been feasible to evaluate the progress made in the use of pesticides, in Colombia. Pesticides are applied on nearly a million hectares, but it is difficult to judge whether the relatively constant quantity used since 1951 represents improved control per unit of pesticides. The wholesale f.o.b. value of insecticides imported has been about 1 percent of the value of all crops produced in recent years.

Fertilizer

Use of fertilizer for agricultural production expanded strongly but irregularly after World War II. Consumption was negligible in the early postwar years through 1950. It then grew rapidly in the early 1950's as foreign exchange was in good supply, and expanded again in the early 1960's as the domestic fertilizer industry was getting established. Throughout the period, the average annual rate of growth averaged 6 percent for total fertilizer, and a little more than 5 percent for total nutrients (the average nutrient content declined slightly in recent years). After 1964, fertilizer consumption showed a more moderate increase. The quantity utilized remained low--between 100,000 and 125,000 tons of nutrients annually from 1964 to 1968--compared with developed countries and some developing countries that are making good progress in agriculture. If about 5 million hectares of land are cultivated (including 1 million hectares

fallow), this usage represents 20 to 25 kilograms per hectare (18 to 22 pounds per acre), moderately above the average for Latin America, and about half the average for developed countries (49, pp. 127-128). Fertilizer is used on 15 percent of the land in cultivation (18, p. 1).

Potatoes lead the field in fertilizer usage. Although less than 2 percent of the total acreage is planted to potatoes, they account for a third of all fertilizer application. It is the one crop in Colombia in which fertilizer is almost always used, and at rates recommended by a committee of specialists.

Fertilization is common for irrigated rice and some minor crops, such as bananas for export, tomatoes, and other vegetables grown for urban markets. Fertilizer use is also significant for wheat, with nearly two-fifths of the area seeded receiving an application. Smaller proportions of the acreage in tobacco, cotton, sugarcane, barley, and coffee account for most of the remaining fertilizer used. Organic fertilizer--principally compost--is of some importance for coffee. Although there is a fairly large number of animals, the manure is of limited value, due to the low level of feeding.

One of the characteristics of fertilizer usage is that it is limited to specific crops produced for sale. Practical problems (for example, financing) are likely to prevent fertilizer usage on subsistence crops. Lack of research results and specific input recommendations add to the uncertainty. While fertilizer usage on seeded pasture is reported to be highly profitable, it is insignificant in Colombia.

Farm Machinery

Considerable mechanization of agriculture has taken place in Colombia

since World War II. All machinery and implements were imported until 1962, when domestic production of simple implements and tools was begun. Mechanization proceeded most rapidly during the mid-1950's when foreign exchange earnings from coffee were at a peak. Imports of agricultural implements were especially high during 1954-56, reaching a peak of around \$25 million in 1956. After sharp drops in 1957 and 1958, farm machinery imports picked up again and continued relatively high through 1962. On balance, farm mechanization was increasing. After 1962, the restriction on imports, although relieved from time to time, was sufficiently stringent to largely halt the spread of mechanization.

The principal information available is for tractors, which account for around half of farm machinery imports. Their numbers rose from 9,000 in 1953 to 15,000 in 1959, 20,000 in 1962, and 23,000 in 1967. The slowdown in the growth in tractors after 1962 was due to reduced imports. The quality of the tractor stock has depreciated considerably during recent years because the average age of tractors has increased. In the earlier part of the period, most of the tractors were relatively new, having been imported during the preceding few years. By 1967, it was estimated that about 33 percent were more than 10 years of age and about 40 percent were in need of major repairs (19, pp. 9-10).

For each 100 tractors, it has been estimated there are 66 plows, 59 rakes, 38 planters, 47 cultivators, 25 farm wagons or vehicles to be towed by tractors, and two or three (portable) irrigation systems. One-third of the tractors are used for towing and not for plowing. About half the towing vehicles are on the sugar plantations. The estimate that there are less than half as many planters and cultivators as tractors is consistent

with the common observation that tractors are less often used for planting and cultivating than for plowing.

Many handtools (hoes, spades, picks, crowbars, machetes, and sickles) and repair parts are now produced by industries within the country to save foreign exchange. Although these domestic products are usually heavier than imports and made from softer materials, they are generally priced about one-third higher (19, p. 53).

The increased use of farm machinery involves a basic conflict between the Colombian Government's agricultural policy objectives of expanding output and employment. Imported machinery and implements are primarily suitable for rather large farms and thus may reduce the competitive position of small farmers. They reduce costs, and for any given scale of operation, substitute for hand labor. On the other hand, they have been closely associated with the expansion in production during the past two decades. The Government has taken two steps to resolve this conflict. After restricting imports from time to time for several years, the Government placed tractors on the free list in 1968. This means that licenses to import tractors are not required or are granted without restriction. The import duty of 2 percent is, in any case, negligible in view of the overvaluation of the currency. Second, attention is being directed to the development of a small, simple, two-wheeled tractor, suitable for use on small plots and fairly steep slopes. A prototype has been shown by the agricultural experiment station in a field day demonstration.

TOTAL FACTOR PRODUCTIVITY

A broad view of total factor productivity was developed by John Kendrick (55)

in considerable detail for the U.S. economy by industry groups, and by Ralph Loomis and Glen Barton for U.S. agriculture (56). Annual inputs of labor, land, and capital are combined to obtain a measure of changes in total input to compare with changes in total agricultural output. Change in total output per unit of total input provides a measure of change in total factor productivity. Measures of change in total factor productivity estimated for Colombia must be regarded as approximations because of data limitations.

On the basis of data assembled for 1950, 1958, and 1967, calculations were made of total factor productivity for the two periods 1950-58 and 1958-67. There was no appreciable difference in the rate of gain in total factor productivity between the early and the late part of the period. In each, the average annual increase was a little above 1.5 percent, as total output rose more than 3 percent and total inputs about half as fast. This is a substantial productivity gain, equal to that attained in U.S. agriculture during the same period, but less than that attained in such rapidly developing countries as Mexico, Taiwan, and Greece.

Partial Productivity Estimates

The data available permit a limited number of partial productivity calculations. In the case of labor, the only information available is from the 1951 and the 1964 censuses of population. During the whole period, the labor force in agriculture is estimated to have increased at a rate of a little more than 1 percent annually, compared with a rate of increase of a little over 3 percent annually in total output. Thus, output per person rose at an average annual rate of 2 percent.

Consumption of intermediate products, such as fertilizer, insecticides, and

seeds, rose faster than output, at an average rate of over 3.5 percent annually. A principal characteristic of such inputs is that they represented a small fraction of output--slightly over 10 percent in 1958.

Cultivated land increased during the 17-year period, 1950-67, at an average rate of a little less than 2 percent annually, with pasture area rising only 0.5 percent annually. The weighted average value of all land in 1958 prices rose 1.6 percent annually, or about half as rapidly as total output of all crops and livestock and livestock products. There was no appreciable difference in the average rise in output in relation to land between the first part of the period and the second. A more specific comparison is that between the output of major crops and the area designated for these crops. As indicated earlier, the rise in output per hectare for major crops was irregular; but for the whole period, it averaged 1.35 percent annually, compared with an increase of 1.8 percent annually in crop area.

AGRICULTURE AND THE GENERAL ECONOMY

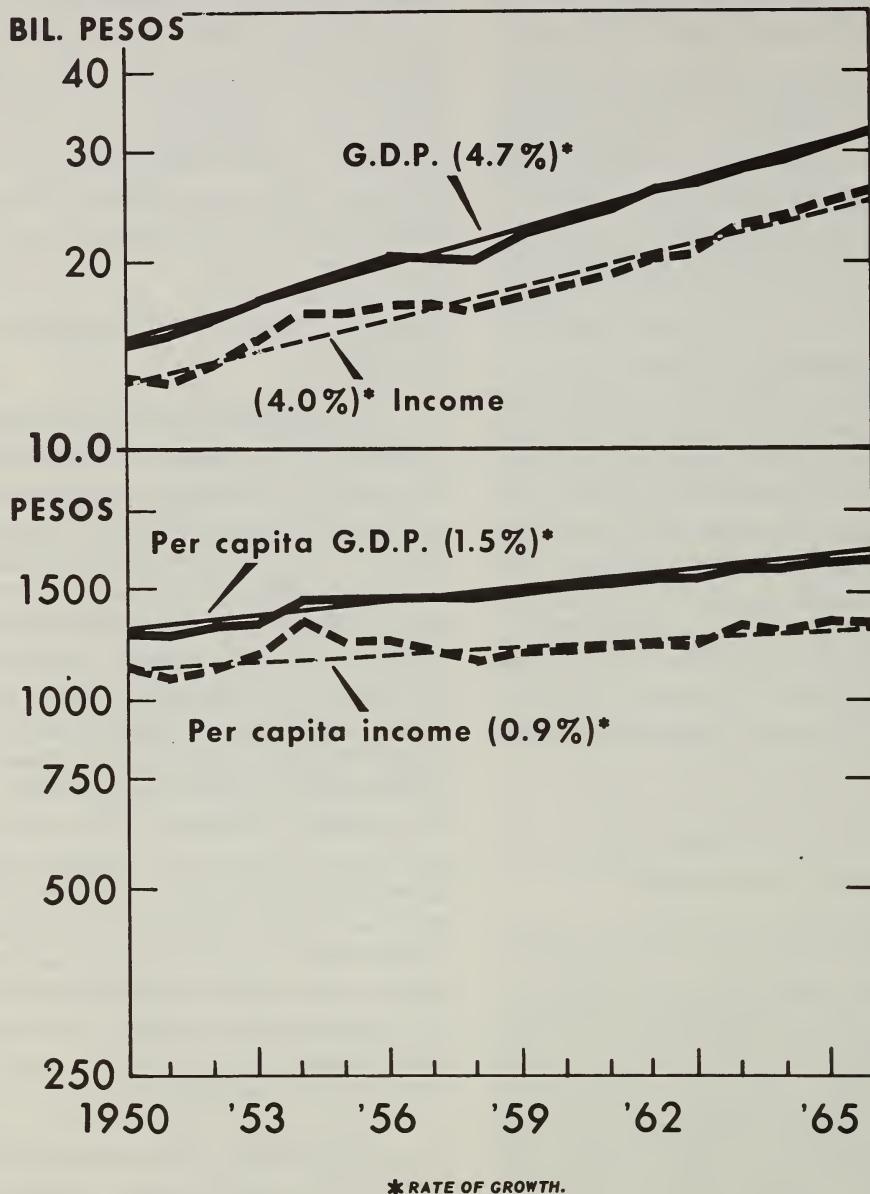
Although expansion in agriculture has been less rapid than in industry, development of the two appear consistent. Their total rates of expansion were relatively favorable. But with rapid population growth accelerating to more than 3 percent annually in recent years, per capita rates of expansion were lower than anticipated. It should not be inferred that population growth has had a wholly negative effect upon the economic development of Colombia. The accounting is easy, but the relationship between population and economic growth is not well understood. Nevertheless, rapid and accelerating population growth represents a major problem.

In general, total output (gross domestic product) advanced rather steadily between 1950 and 1967 at an average annual rate of 4.7 percent, but the rate of growth of output per capita showed wide variations (15, fig. 25). Per capita growth was substantial during the early 1950's and negligible for a few years thereafter (1954-58). During 1959-67, per capita growth was resumed at a rate about half as fast as in the early 1950's, with occasional pauses in recent years. For the 17-year period, per capita GDP increased at an average annual rate of 1.5 percent.

Real national income is another concept which is useful to measure growth. In addition to being an income concept instead of a gross output measure (i.e., adjusted for depreciation), real national income is also adjusted for foreign exchange loss or gain attributable to price changes; in Colombia, these are chiefly changes in coffee prices. Real income per capita rose more rapidly than output per capita during 1952-54, but then showed a substantial decline through 1958 (fig. 25). Thereafter, recovery was slow and halting to such an extent that a full decade elapsed after the 1954 peak before real per capita income again reached the earlier high. Thus, there was not a sustained rise in income throughout the period, but in 1967 real income per capita was about one-fifth higher than in 1950. The annual rate of increase averaged almost 1 percent.

Throughout the period, industrial production grew more rapidly than agriculture. Agriculture's proportion of total output at constant factor prices declined from 40 to 31 percent, whereas manufacturing industries rose from 14 to 18 percent during the 17-year period. This much noted shift is a well-known characteristic of economic development; it illustrates the consistent growth of agriculture and industry, which (in the

COLOMBIA: TOTAL AND PER CAPITA REAL GROSS DOMESTIC PRODUCT AND REAL NATIONAL INCOME



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Figure 25

spirit of Hirschman) may be a secondary trait rather than the primary goal of rapid growth regardless of balance (43).

Manufacturing has developed a relatively modern sector of well-designed factories with considerable labor-saving machinery where value added per person employed is relatively high. This contrasts sharply with traditional handicraft industries, where value added per person is even lower than the average for agriculture. Value of production is about five times as high in the factory group as in the handicraft group, although employment (at 5.3 percent of the labor force) is slightly lower (78).

Modernization of industry and agriculture--a slow process--became significant after World War II. The modern subsectors were formed by new industries using technology from developed countries. This was largely unavoidable, since development of a new technology is extraordinarily difficult. Nevertheless, use of capital-intensive methods has meant a relatively small increase in employment in these industries. In recent years, the slow rise in domestic demand for products of the modern factory sector and the limited penetration of foreign markets have resulted in a limited rise in employment with most industries operating well below capacity.

As in many developing countries, rural migration to cities has been substantial. In 1950, the rural population accounted for 62 percent of total population; by 1966, it was less than half. Initially, the migration was mainly a consequence of political unrest when farmers sought protection in cities; later on, wage differentials and better living conditions caused large increases in the urban labor force.

Total employment has risen more slowly than the labor force in recent years. Unemployment in the larger Colombian cities is about 14 percent, and approximately 10 percent for the country as a whole (79). It is considerably higher than it was 15 years ago (17). No estimates have been made of rural unemployment.

Colombia's export earnings peaked in the mid-1950's, due to high coffee prices. During this period of high and rising coffee prices, imports were not closely controlled, and financing by suppliers was available and used generously by importers. After the international coffee prices fell, an attempt was made to reduce the impact on income in the coffee sector, and to avoid further decreases in price. To accomplish these aims, the Coffee Federation began to purchase surpluses, an action that also implied additional inflationary pressures.

By the late 1950's, it became clear that new export products needed to be developed, since most observers believed the high coffee prices of 1954 would not recur. In the initial phase, when development of an import-substitution policy was emphasized over active export promotion, the economy made good gains (16).¹⁵ Factory industry came to be the most dynamic sector of the economy. But when the import-substitution possibilities became unquestionably limited by the mid-1960's, this policy increased the import requirements of domestic manufacturing, and created pressures on the balance of payments.

After 1962, investment began to slow down; coffee prices continued weak, rising briefly in 1964, and fiscal and monetary

^{15/} Nelson, Richard R., Schultz, Paul T., and Slichton, Robert, Colombian Development Policy (preliminary draft), 1968.

problems developed. The result was that the expected acceleration in the growth rate did not materialize. Despite heavy restrictions on imported goods--relaxed when pressures become unbearable--large deficits developed from 1962 to 1965. Inflationary pressures led to successive crises in 1965 and 1966.

It was clear that failure to obtain new sources of foreign exchange was a major cause of the maladjustment. The country found itself unprepared to begin massive exports, mainly because of high cost structure, both in the agricultural and manufacturing sectors. With insufficient fiscal resources, Governmental investment had to be reduced despite forced loans from the banking system. The economic climate deteriorated. This meant a substantial decrease in private investment and mounting difficulties in getting international financing to keep the economy moving. Tight credit restrictions were imposed which hurt the manufacturing and tertiary sectors. Agriculture appeared to fare as well as other industries, favored by special institutions and legislation that increased allocations and reduced interest rates, but the credit stringencies were quite general.

An export subsidy was offered for minor exports to partially offset overvaluation of the peso. A system of flexible exchange adjustment provided the mechanism for gradual change. In 1967, coffee accounted for 58 percent of total exports; minor exports represented 23 percent of the total, compared with 8 percent in 1958. In 1968, minor exports accelerated sharply, and preliminary reports for 1969 showed continued strength. The Government has set a target of \$300 million in earnings from minor exports in 1970.

The Government's influence upon economic development during most of the

period under review was limited by: (1) the relatively small proportion of total output available through taxation; (2) the necessity to take emergency action; and (3) the slow growth in tax revenues.

Nevertheless, after the 1965-66 emergency, the Government took reform steps beginning in late 1966 to effect an improvement in the foreign exchange situation and in tax receipts. After good economic progress in 1968 and 1969, foreign exchange earning prospects were brightened at the end of 1969 and early 1970 by a large rise in coffee prices following crop damage in Brazil and by the flow of oil through a new pipeline from the Putumayo area to the Pacific coast. Thus, toward the end of the 1960's, the basis was laid for an improvement in the performance of the economy, and the most recent figures reflect such improvements.

Domestic Production of Non-traditional Inputs

An important relationship between agriculture and industry is the development of modern inputs by industry for agricultural production and agriculture's demand for such inputs. Principal products produced by industry for agricultural inputs include fertilizers, chemicals (mixed from imported raw materials), feed, and simple farm tools. The Colombian fertilizer industry began in 1963 and is mixing almost all fertilizer consumed in the country. The nitrogen used is produced domestically.

Pesticides used in Colombia are mostly imported, but a small quantity is mixed domestically from imported materials. Production and distribution of improved seeds is an enterprise of some importance. The less complicated agricultural implements are produced, and a few are exported. Chicken hatcheries are developing, and there is a small but

growing feed industry. Although these agricultural supply industries are still small, they have expanded to provide increased inputs for agriculture and have partially replaced supplies formerly imported.

Capital and Credit

The flow of capital between agriculture and nonagriculture--an important component of development--has received considerable attention. Credit stringencies in agriculture have reflected general credit tightening. Lack of availability of credit does not appear to have been of crucial importance in limiting agricultural development in Colombia (76, p. 5).

More Farmworkers Than Jobs

One of the traditional functions of agriculture and rural areas is to provide an excess of manpower for urban employment. As agriculture becomes more productive, the proportion of total employment on farms declines. So far, urban employment demands have been rising slowly. With the high rate of natural population growth in rural areas, rural population is continuing to increase more than 1 percent annually. There is substantial underemployment in rural areas. Meanwhile, migration from established agricultural areas (i.e., the area west of the largely uninhabited eastern flatlands) continues unabated. Large urban areas are the principal destination, but many farmpeople have moved to the new settlement areas, principally in the piedmont strip between the mountains and flat plains or jungle lands to the east. There is general approval in Colombia of the movement of small landholders (minifundistas) and landless to the eastern frontier settlements. The land reform agency (INCORA)

is extending help to a considerable portion of these settlers by building access roads, providing technical assistance, credit, and livestock, promoting the development of unfamiliar crops adapted to the region, and organizing cooperatives to purchase supplies and to market products. A colonist can homestead a tract of around 50 hectares, and sometimes receive credit and technical advice to begin the conquest of the remote jungle strip with an ax, a hoe, a mattock, a machete, and a hand sickle. However, the more massive movement of farmworkers to the large cities is a troublesome, highly visible problem demanding attention.

Income Distribution

Although the usual reservations on income distribution data are applicable to Colombia, a series of competent analyses show the general picture. Inequality in income distribution is appreciably greater in Colombia than in the United States and most developed countries. Such inequality is characteristic of Latin America, and Colombia occupies an intermediate position among these countries (77, p. 245). There is also great inequality in the distribution of ownership of agricultural land in Latin America, with Colombia's position again intermediate.

The best information available on income distribution is for 1961 (84, pp. 224-225). In that year, 11 percent of the lowest income group (under 1,000 pesos) in the labor force received less than 2 percent of the national income. The lowest 65 percent received only 26 percent of the national income. At the upper end, less than 1 percent received 12.5 percent of the income, and 2.15 percent received 18.95 percent. The degree of inequality appears to have increased during the past 15 years (78). The principal influences were a rise in unemployment and a slow growth in jobs in the modern sector.

Agricultural Prices and the General Price Level

The general price level has advanced about 10 percent a year since 1950. This is below the hyperinflation occurring in a number of Latin American countries, but it is substantial in relation to world prices during this period. Periodic devaluations of the currency have been required. However, these devaluations have not occurred promptly when the currency became overvalued as a result of internal price advances. For complex reasons, adjustments to inflation are not "institutionalized" and more or less automatic (as in the case of some of the countries undergoing hyperinflation).

Although the rise in prices since 1950 has been rather general, it has not been steady. On an annual basis, prices did not advance in 1952, when there was a slight decline in wholesale prices. The advance was renewed in 1953, and accelerated in 1954 as agricultural prices moved upward sharply. Prices leveled off in 1955, and then began to rise in an advance that was almost uninterrupted, even on a quarterly basis. Advances were large in 1957, 1963-64, and 1965-66. A slowing down in the price advance in 1967-68 continued through 1969.

Farm and Nonfarm Prices

Throughout 1950-66, agricultural prices rose at about the same rate as non-agricultural prices (fig. 26). Agricultural prices were highest in relation to non-agricultural prices in 1954, culminating a long relative advance during World War II and several postwar years. This was a period when farm prices throughout the world rose more rapidly than nonfarm prices.

After 1954, Colombian agricultural prices rose somewhat less rapidly than

nonagricultural prices, so that the ratio of farm to nonfarm prices drifted irregularly downward until 1962 when the ratio was about the same as in 1950. A severe drought during 1963 was followed by a larger increase in agricultural prices. Since then, agricultural prices have risen less rapidly than nonagricultural prices. The ratio of agricultural to nonagricultural prices declined in 1966 and 1967 to below the average for the 1950-66 period.

If coffee is excluded, however, farm prices rose somewhat faster than non-farm prices (fig. 27). Prices of the traditionally cultivated crops of Group 2--yuca, beans, plantains and panela--rose especially. In 1967, the average price of all farm products except coffee was a little higher in relation to nonfarm products than the average relationship for the full period, 1950-66.

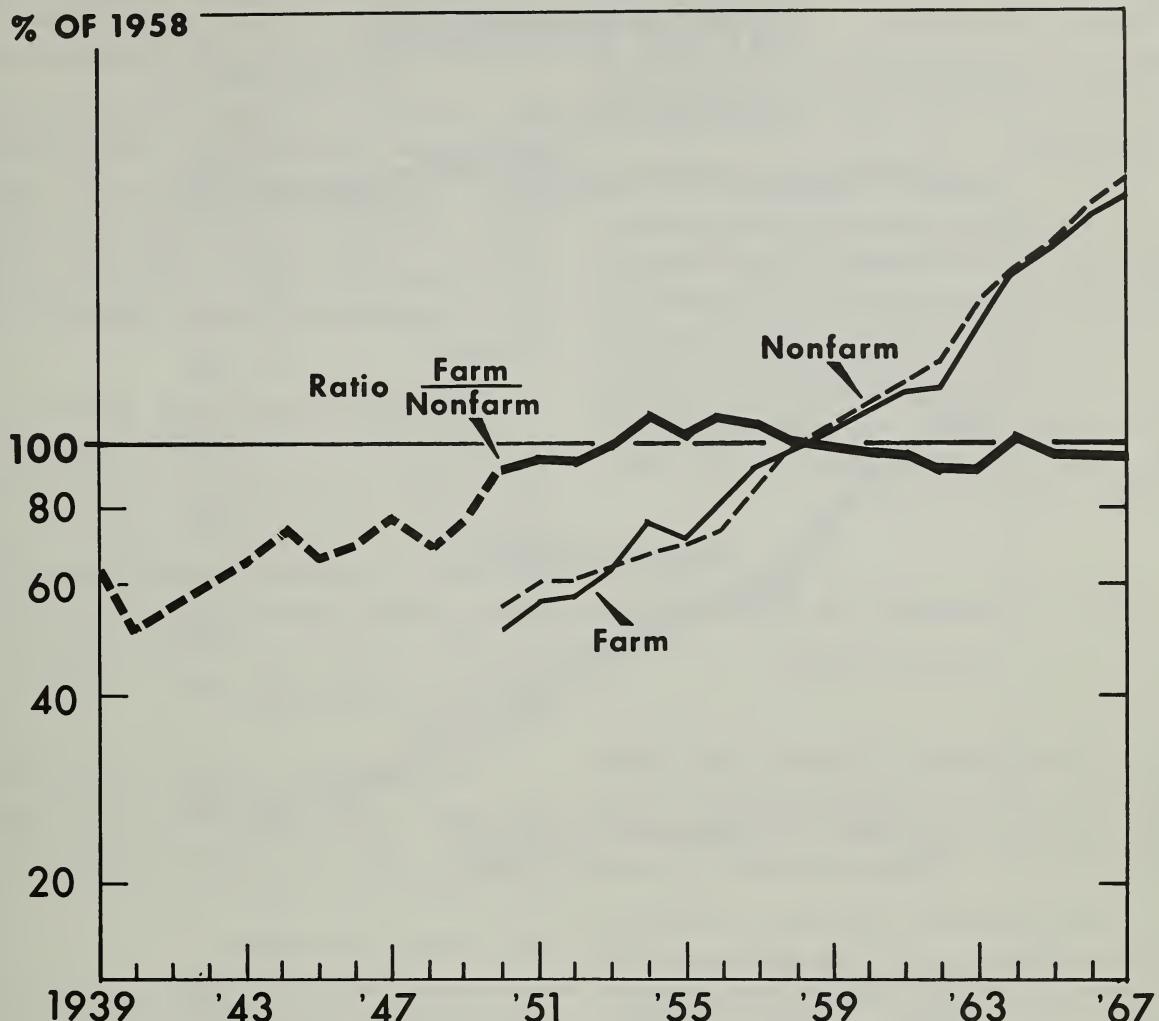
Rural Living Conditions and Community Facilities

Community facilities, transportation, education, and housing for farm-people are important influences affecting agricultural production and productivity.

Transportation and education are two areas of notable deficiency in Colombia. These services have been especially inadequate for rural residents. Tangible progress has been made in each during the past two decades. Transportation progress has been remarkable, as a large proportion of the fixed investment of the nation has been directed to this area. Nevertheless, rural roads leading to farms have received little attention, so that isolation of farms is a serious constraint on agricultural development.

Progress in rural education has been less visible, but substantial in the last 10 years. However, rural education

COLOMBIA: FARM PRICES AND NONFARM PRICES



FARM PRICES HAVE RISEN AT ABOUT THE SAME RATE AS NONFARM PRICES DURING THE LAST TWO DECADES.

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Figure 26

is so deficient that it limits the possibilities of youth who remain on the farm as well as those who enter nonfarm occupations. In 1964, more than two-thirds of rural schools offered instruction only through the second grade, and most of the rest ended with the third grade.

The general lack of community facilities for rural residents causes many of the more prosperous farm entrepreneurs to live in urban areas. The consequence is a distinct disadvantage for the farm community, and the possibility of building or strengthening the "agricultural ladder" for step-by-step advance for the individual has been limited.

VARIED PROGRESS IN COLOMBIAN AGRICULTURE

Technological progress has been rapid in some areas and for some crops, but almost nonexistent in other areas and for other crops.

Unfortunately, there is no relatively simple explanation for this diversity. The progressive farmer has so many advantages that expansion seems easy and natural, whereas the peasant on the hillside appears to be "locked in" by a severe complex of restraining influences. Among these are the peasant's small scale of operation; limited access to and use of capital and modern technology; isolation; and lack of markets, roads, and transportation facilities. Added to these are problems of undernourishment, health, overpopulation, and underemployment. Above all, the rural educational effort fails to provide sufficient training in basic skills (functional literacy) or the elementary and intermediate schooling required for addi-

tional technical or managerial training. Given these formidable barriers, the Colombian peasant farmer appears unresponsive to price, profitability, or adoption of progressive farming practices.

Finally, it must be recognized that although the "progressive" farmers are only "relatively modern," with much unused potential to produce more efficiently at lower costs, they still have more flexibility than the traditionalists where expansion of farming operations is concerned.

Similarly, almost any general aid provided by the Government is likely to be more helpful to the progressive, expanding group--and more quickly utilized by them--than to the traditionalists, unless such help is specially slanted toward the latter. Special help will be required for the great majority of small traditional farmers if they are to participate in agricultural expansion.

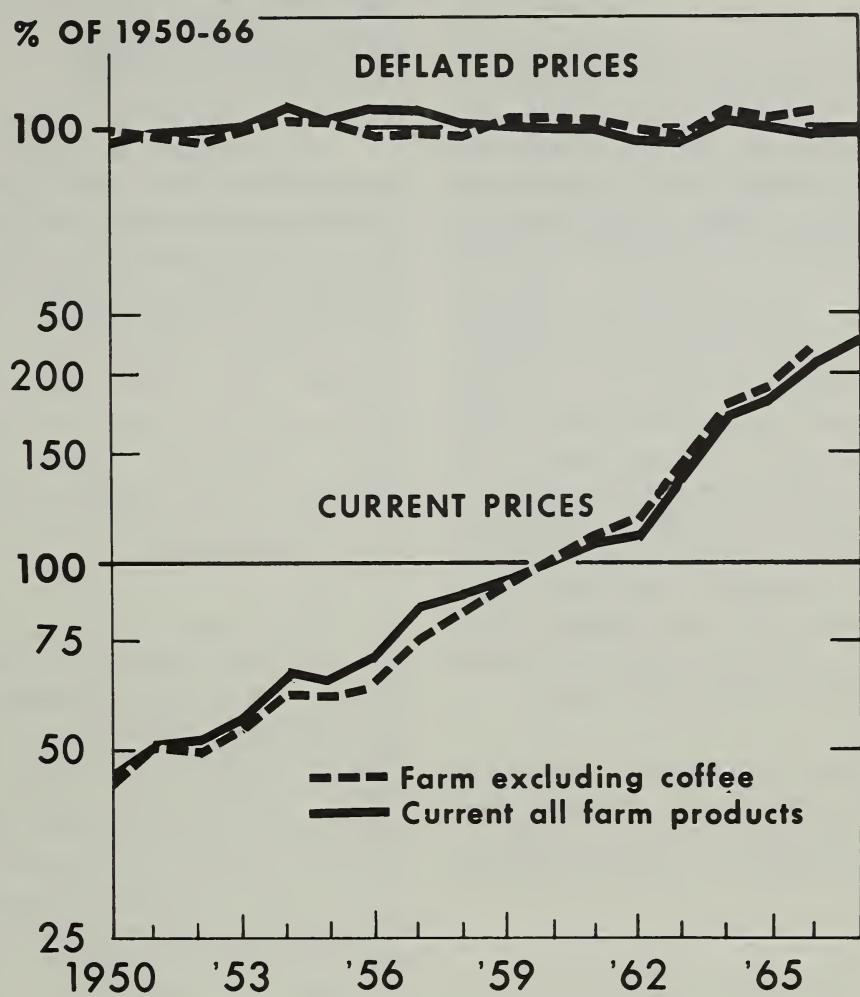
Furthermore, solution of Colombia's per capita farm production and income problems goes far beyond merely increasing agricultural productivity.

Role of Improved Inputs

Transformation of agriculture from a relatively traditional to a relatively modern, progressive production process may be visualized in terms of inputs and outputs. In this restricted sense, the problem of slow development is the limited use of more productive inputs. Solutions to these remediable deficiencies lie with the Government.

For crops other than those in Groups 4 and 5, slowly rising yields appear to be associated with a limited use of fertilizer, improved seeds, control of weeds, disease, and insects, improved cultivation, and modern techniques of soil and water

COLOMBIA: ALL FARM PRICES VS. FARM PRICES EXCLUDING COFFEE



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Figure 27

management. It seems clear that these inputs must be expanded if crop yields are to accelerate.

A minimum effort to overcome the greatest deficiencies in agricultural production might concentrate on expansion of inputs of a complementary character such as fertilizers, better seeds, and chemicals to control weeds, insects, and diseases. Each of these already has received considerable attention in Colombia.

But the possibilities of the combination of improved seed and fertilization have been explored only to a limited extent, although Colombia has a firm basis for supplying each of these inputs, with only limited requirements for foreign exchange. A long and distinguished program of plant genetics and seed development has produced improved varieties which form the basis for accelerating seed multiplication and more general usage for the principal commercial crops.

Investment has already been made in fertilizer plants with capacity well beyond the achieved rate of production, and additional capacity is being installed.

Short-Term and Long-Term Needs

A program to increase the use of non-traditional inputs is appropriate for short-term needs.

The longer term need is for more research and development, since new varieties are always required to keep ahead of insects and disease, and realistically, to keep pace with progress elsewhere. When other countries, even fully developed ones, make progress in improving production and reducing costs,

Colombia loses ground in a very real sense if it does not make comparable advances. For example, if a product is being sold abroad in competition with other countries, the loss will be direct and prompt, for international prices will decline, reflecting costs.

Improvement in production through increased use of nontraditional inputs would neglect a series of general problems. These include the problems of increasing labor productivity through mechanization, agrarian reform in the most general sense, the development of research and other agricultural institutions, and the need for infrastructure. These long-term needs are fully as important as persuading farmers to use more nontraditional inputs to meet short-term requirements.

Since time is required to achieve results, there must be a continuation--and perhaps an intensification--of present commitments. Marketing is in a slightly different category. The present marketing system is geared to current levels of production. If agricultural output exceeds population growth, the present marketing system will require reorganization and improvement. Accordingly, an increase in production will require a simultaneous improvement in marketing.

Progress and Equity

It has been shown that the farming operations with the greatest flexibility for expansion are the larger ones, utilizing mechanical equipment and relatively modern technology on generally level fertile soils, in or near well-developed areas and growing selected crops of Groups 5 and 5A. These farmers will likely be the first to benefit from a general program to increase nontraditional inputs.

If, however, inputs are not subsidized--and for this group subsidization is neither needed nor defensible--there can be no objections on the basis of equity if these large farmers use more and better inputs to expand production. This is particularly true if special programs are introduced for traditional farmers.

Because of the many disadvantages under which the small traditional farmer is operating, his participation in the use of nontraditional inputs to expand output will require special attention and help.

He may need an individually tailored program to help him adopt improved practices and to purchase the inputs required by new technology.

Thus, to the extent desirable, a compromise could be made between "productive" efficiency and equity in the allocation of resources for agricultural programs. Such a plan could be quickly adopted, while longer term, but no less important, remedies were sought in both rural and urban areas.

Chapter IX. BRAZIL: ROOM TO GROW

By Louis F. Herrmann

Brazil achieved an overall economic growth rate of 5.2 percent between 1947 and 1965. Agricultural output grew somewhat less, ranking between services and industry. Industrialization was a high priority objective of public policy throughout the period, supported by direct investment, accelerated public works on highways, power supply and similar services, and policy instruments, such as exchange controls and tariffs.

Most of Brazil's economic activity, including agriculture, is concentrated in a relatively narrow strip in the east and south. The interior is practically untouched. Less than 1 percent of the 6 million hectares in the frontier States was in crops in 1960, compared with 10 percent of the 2.5 million hectares in the settled States. It is not surprising, then, that Brazil's agricultural growth from 1947 to 1965 came mainly from increases in cropland. It appears that this growth could be sustained at the same rate for at least another two decades. Thus, the relative emphasis to be placed on raising crop yields versus expanding area under cultivation is a vital development issue in Brazil.

BACKGROUND

Brazil is the world's fifth largest nation in land area and the most populous in Latin America. Independent since 1822, Brazil was a constitutional monarchy until 1889, when it became a federal republic.

Agriculture has long been Brazil's principal economic activity and chief

source of foreign exchange earnings. Export crops have been emphasized since the early 16th century. Sugar was the dominant crop until early in the 19th century, when coffee took the lead. Second place in agricultural exports after 1820 fluctuated among sugar, rubber, and cotton.

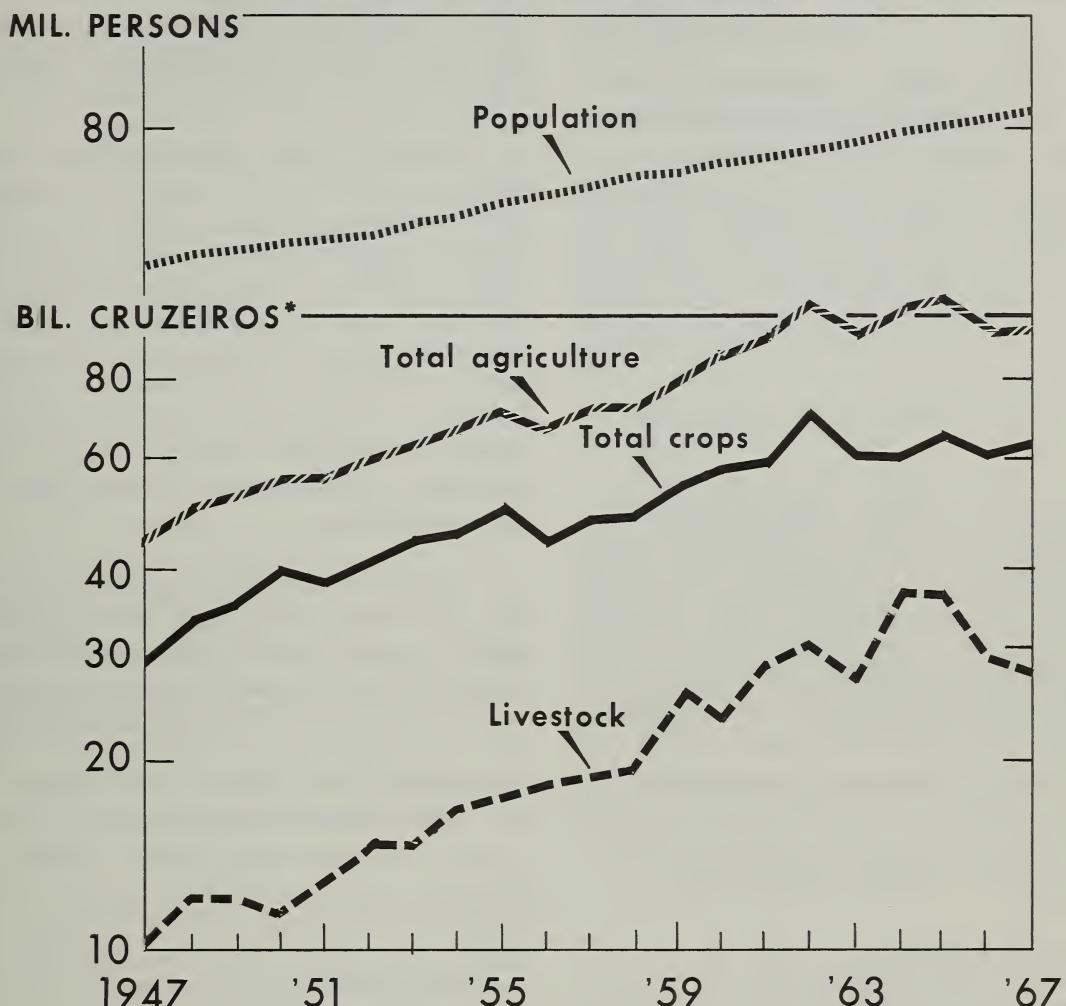
Export commodities continued to hold the center of attention in the 20th century, but production for domestic markets unobtrusively crept up to a dominant role in the economy. Farm value of both rice and corn exceeded that of coffee with increasing frequency in the 1960's, and export crops occupied only about 30 percent of the cropland in 1963-65.

Although Brazil directed its development efforts toward industrialization following World War II, agriculture continued to account for between 25 and 30 percent of gross national product. About half the labor force was in agriculture in 1960.

Agricultural output grew more rapidly than population in the 1950's and 1960's, notwithstanding the priorities given to industrialization (fig. 28). Yet, Brazilians were deeply concerned because crop yields remained low, and because most farmers continued to follow traditional farming practices.

Despite some dissatisfaction with the progress of agriculture following World War II, the farming sector shared somewhat in the general social progress of the period. Education, health, and various social welfare programs were begun or expanded. An agricultural extension service was established, and agencies were set up to assist farmer

BRAZIL: VALUE OF AGRICULTURAL PRODUCTION IN CONSTANT 1949 PRICES AND TOTAL POPULATION



* 18 cruzeiros (1949 prices) = US\$1.

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Figure 28

cooperatives, promote colonization and other measures for agrarian reform, and administer minimum prices for important farm products. Educational facilities in rural areas were expanded, and programs at secondary school and university levels were improved. Major commodities--coffee, sugar, rice, and cocoa--continued under quasi-public "institutes" which regulated marketings and otherwise promoted the interests of producers.

The physical setting of Brazil's agriculture strongly influences both its history and its prospects. Stretching from 5 degrees above the equator to 34 degrees below it, the country shares the tropical problems that burden much of the developing world. The climate ranges from tropical to subtemperate. Rainfall over most of the country averages 40 inches or more annually. Topography of much of the south, east, and northeast is mountainous or deeply eroded, but the interior has a more gentle terrain. Soils are mainly latosol and laterite, relatively low in natural fertility and unresponsive to fertilization (71). In the South some soils are highly fertile, however. Natural vegetation ranges mostly from dense jungle to the sparse trees and mixed brush and grass of the campo cerrado and caatinga.

Early settlement clung to the coast because of unfriendly terrain in the immediate hinterland. By 1960, the geographic center of population was still only 300 miles inland.

Population grew slowly--less than 2 percent a year between 1550 and 1940. After 1940, death rates were reduced sharply. With birth rates remaining stable, the rate of population growth rose to 3.1 percent between 1950 and 1960.

The agricultural census of 1960 counted 3.3 million farms in Brazil. Size,

type of ownership, and tenure patterns were extremely varied. Land ownership was widely diffused, with two-thirds of the farms and land being owner operated. Approximately half the rural properties registered in 1967 ranged in size from 10 to 100 hectares. Properties of more than 100 hectares accounted for about 40 percent of the total area (10,11).

Social and political institutions continue the diversity that characterizes other aspects of the country (33, 80). Family patterns encompass the patriarchal system of the great estates, the European peasant system, and, among laboring classes, African and Amerindian culture. Religion is predominantly Roman Catholic; church and state are somewhat further separated than in most Latin American countries, but closer than in the United States.

Brazil's system of government and the allocation of powers and responsibilities among local, State, and Federal jurisdictions have had a distinct influence on the evolution of Brazilian agriculture. The local government unit is the *municipio*, which corresponds to the county in the United States. The *municipio* lacks a strong tax base, and without State and Federal aid has difficulty in providing adequate roads and schools. State governments have long exercised considerable autonomy in political and economic affairs, but vary greatly in the services provided to agriculture. The Federal Government has a broad range of activities relating to agriculture dispersed through several ministries. The Ministry of Agriculture accounted for about half the Federal expenditures budgeted for agriculture and rural development in 1968.

Transportation has been a major problem in the economic development of Brazil. Both the rail and highway systems

developed slowly and haphazardly. As recently as 1968, important links between separate sections of the rail system remained to be completed, and the diversity of gauges in use was a burden on freight service. Highway building has emphasized the main arteries. Few secondary roads are paved, and a survey in 1965 found that the roads to 11 percent of the farms were impassable for 60 days or more each year. The average length of roads per 1,000 square kilometers in 1965 was between 300 and 400 kilometers in most of the more fully developed States, less than 100 in some actively growing frontier States, and less than 1 in most of the North.

Brazil's great size has led to wide diversification in agriculture. Seven leading crops each accounted for 7 to 17 percent of the total value of output of 26 crops in 1963-65; the combined value of the seven crops was 78 percent of the total. Rice took over first place from coffee in 1962. From 1962 through 1968, coffee ranked second or lower, except in 1965, when it regained first place.

In some States, specialization is very high, with the leading crop accounting for more than half the total crop output. On the other hand, an appreciable number of States are highly diversified, with the leading crop accounting for less than one-third the total crop output.

At least 11 generalized agricultural regions are recognizable, but for practical purposes, five census regions (definitions in use through 1967) represent the principal regional differences adequately. The South leads in value of agricultural production with about one-half the national total (table 47).

GROWTH IN OUTPUT, 1947-65

Brazil's agricultural output grew at a compound annual rate of about 4.5 percent during 1947-65, with rates calculated from several available measures agreeing within a few tenths of 1 percent. Year-to-year variations of output around the long-term trend were generally small, reflecting the stabilizing influence of

Table 47.--Brazil: Total value of output of 34 agricultural products, by census regions, 1947-49 and 1963-65 annual averages

Region	Value of output in constant prices			
	1947-49		1963-65	
	Billion Cr\$	Percent	Billion Cr\$	Percent
North	4	2	7	2
Northeast	32	15	65	16
East	62	31	101	24
South	99	48	204	50
Central West	9	4	35	8
Brazil	206	100	412	100

Source: (9).

diversity of products and wide geographic range. An index of output specially constructed to provide information about changes by products and areas (States and regions) indicated a growth rate of 4.6 percent.

Total value of output of 34 products increased from 206 billion cruzeiros annually in 1947-49 to 412 billion cruzeiros in 1963-65 (table 47). ^{16/} Agricultural output increased more in some regions than in others. The Central West, (Mato Grosso and Goias) for instance, nearly quadrupled its output, which moved from 4 percent to 8 percent of the national total. The East, on the other hand (principally Minas Gerais and Bahia), grew

^{16/} The 34 products accounted for about 99 percent of the total value of agricultural products. Values were calculated with 1957-59 average prices. The rate of exchange was 123 old cruzeiros (0.123 new cruzeiros, NCR\$) to the U.S. dollar.

much more slowly than other regions, and its share of the total fell from 31 percent to 24 percent. By regions, annual growth rates for 1947-65 ranged from 3.2 percent to 8.4 percent (table 48). Even within regions, agricultural output growth rates tended to vary considerably from State to State. In the Northeast, Maranhao had the most rapid rate of growth (7.9 percent), the fourth most rapid in Brazil. In the South, Parana grew at 10.8 percent a year; this was the highest in the nation and more than twice the rate of growth in any of the other three States of the region. Output grew slowly in the important agricultural States of Minas Gerais (2.8 percent) and Sao Paulo (3 percent) (table 49). Parana contributed one-third of Brazil's increase in agricultural output from 1947-49 to 1963-65, largely through an increase in cropland. Sao Paulo contributed another one-third. Increased output per hectare was a substantial (but less than a majority) factor.

Table 48.--Brazil: Compound annual growth rates in total output of 34 agricultural products, by census regions, selected periods, 1947-65

Region	Growth rate ^{1/}		
	1947-65	1947-56	1957-65
	<u>Percent</u>		
North	3.8	2.8	5.5 ^{2/}
Northeast	4.7	3.0	8.1 ^{2/}
East	3.2	2.8	2.6
South	4.8	5.0	4.0
Central West	8.4	9.4	9.3
Brazil	4.6	4.2	4.6

^{1/} Value of b in mathematically fitted least squares function $Y=ab^X$. ^{2/} Difference from growth rate for 1947-56 is statistically significant by F-test at the 5-percent level.

Source: (9).

Table 49.--Brazil: Compound annual growth rates in total output of 34 agricultural products, by States, 1947-65

State	Growth rate	State	Growth rate
	<u>Percent</u>		<u>Percent</u>
NORTH		EAST	
Rondonia	1.9	Sergipe	4.0
Acre	2.6	Bahia	3.5
Amazonas	6.3	Minas Gerais	2.8
Roraima	5.0	Espirito Santo	4.3
Para	3.6	Rio de Janeiro	3.5
Amapa	1.3	Guanaabara	<u>1/</u>
NORTHEAST		SOUTH	
Maranhao	7.9	Sao Paulo	3.0
Piaui	5.7	Parana	10.8
Ceara	4.8	Santa Catarina	4.2
Rio Grande do Norte	3.6	Rio Grande do Sul	4.0
Paraiba	4.8	CENTRAL WEST	
Pernambuco	3.8	Mato Grosso	8.2
Alagoas	4.1	Goias	8.7
		Distrito Federal	<u>1/</u>

1/ Data incomplete.

Source: (9)

Output Growth Relative To Needs

Total agricultural output comfortably accommodated the combined effects of increases in population and income over the 1947-67 period. Food crop output increased at a compound annual rate of 4.7 percent, and livestock output 4.9 percent, while total food demand increased

4.3 percent. 17/ Acute shortages of beef were experienced in the mid-1960's with production increasing at an annual rate of 3.1 percent. This rate of growth barely kept abreast of population, leaving nothing to offset increased income.

17/ Food demand is estimated from population growth rate of 3.12 percent, increase of 2.4 percent in per capita real income, and coefficient of income elasticity of demand of 0.47.

In the midst of general inflation, food prices rose steadily relative to other prices until 1962. Government controls, being more effective on non-food items such as rents than on food, contributed to the disparity in prices. Eventually, more fundamental steps were taken to control inflation. Price controls were relaxed, and relationships between the index of food prices and the index of all prices in the cost of living began to reflect the fundamentally favorable food supply situation.

While agriculture seems to have performed adequately in supplying food needs, it may have contributed less effectively to the purchasing power of the rural market for the growing output of industrially produced consumer goods. The index of producer prices rose less rapidly than either retail or wholesale food prices, but the divergence may be overstated since the producer price index gives increasing weight to the low prices on the frontier. Labor productivity in agriculture tended to rise, but how much this may have affected rural purchasing power is conjectural.

MAJOR SOURCES OF GROWTH IN AGRICULTURAL OUTPUT, 1947-65

The value of output of 34 products increased 204.3 billion cruzeiros between 1947-49 and 1963-65 (table 50). Increased crop area and livestock numbers accounted for 85 percent of the addition to output; increased yield, 11 percent; input times yield interaction, 10 percent; and net change in crop pattern, -6 percent.

Crop Patterns

Crop changes were very complex. There were shifts in location of production, causing the value of output to fall 8 percent below what it would have been if each

State's share of total output had remained at the 1947-49 level. There were shifts in the relative importance of individual products. Output of products with higher value per hectare (or per equivalent animal unit) increased relative to low value products, adding 1 percent. A small positive interaction in crop patterns also added 1 percent.

Crop Area and Livestock Numbers

Crop area increased by more intensive use of land already in farms at the beginning of the period as well as by adding new land. The group of "old" States added 5.8 million hectares of cropland, at a compound annual rate of 3 percent, between 1950 and 1960. Frontier States added 3.8 million hectares, at the annual rate of 9 percent.

Cropland increased from 8 percent of the land in farms in 1950 to 11 percent in 1960. Many of the older settled States had about 25 percent of land in farms in 1960. Some had already reached 20 to 25 percent as early as 1940. Much farmland in the older areas is not arable so the ratio of cropland to arable land in these areas tends to be characteristic of a fairly intensive agriculture.

Nationally, livestock numbers increased more slowly than cropland. The most rapid increases in livestock numbers were in the frontier States of Parana, Mato Grosso, Goias, and Maranhao, where crop area increased even more rapidly. Livestock numbers tended to increase more uniformly throughout the country than did crop area. Consequently, in most of the older States, livestock numbers increased more rapidly than crop area.

Output per unit of input (hectares of cropland plus equivalent animal units of livestock) increased about 0.6 percent a year between 1947 and 1965. Only a small

Table 50.--Brazil: Principal components of change in agricultural output,
1947-49 to 1963-65

Crop pattern components	Total change	Factor component		
		Input	Yield	Interaction
		⋮	⋮	⋮
		- - - Billion cruzeiros - - -		
Gross	204.3	186.6	14.0	3.7
Pure	217.5	174.0	23.1	20.4
Crop pattern	-13.2	12.6	-9.1	-16.7
⋮	⋮	⋮	⋮	⋮

Components of crop pattern

Location	Product	Components of crop pattern		
		Location	Product	Total crop pattern
Location	Product	-16.5	-6.4	-4.7
Product	Location X product interaction	2.0	5.5	-1.2
Location X product interaction	⋮	1.3	13.5	-3.2
⋮	⋮	⋮	⋮	⋮
Total crop pattern	⋮	-13.2	12.6	-9.1
⋮	⋮	⋮	⋮	⋮

Components of change expressed as a percentage
of total gross change

Gross	Pure	Percent		
		Gross	Pure	Crop pattern
Gross	Pure	100	91	7
Pure	⋮	106	85	11
Crop pattern	⋮	-6	6	-4
⋮	⋮	⋮	⋮	⋮

Components of crop pattern

Location	Product	Components of crop pattern		
		Location	Product	Total crop pattern
Location	Product	-8	-3	-2
Product	Location X product interaction	1	3	-1
Location X product interaction	⋮	1	6	-1
⋮	⋮	⋮	⋮	⋮
Total crop pattern	⋮	-6	6	-4
⋮	⋮	⋮	⋮	⋮

Source: (9).

part of this increase was attributable to better crop varieties, heavier use of fertilizer, or other technological advances in crop production. Most was due to greater productivity of livestock, particularly an increase in proportion of cows milked (table 51). (Since statistics on milk cow numbers were not available, it was impossible to refine the measure of livestock productivity any further).

Yields

Gross crop yields showed almost no increase (table 52). After eliminating the effects of shifts among locations and crops, pure yields declined about 0.1 percent a year. There was, of course, considerable variation among crops, with pure yields of tomatoes increasing 2.2 percent a year, and cocoa yields declining 2.4 percent.

For more than 100 years, observers of Brazilian agriculture have attributed declining yields to exhaustion of soil fertility. This is the chief reason cited for the disappearance of coffee groves

from the Paraiba Valley and other areas they once covered. Yields of major crops in the four most dynamic frontier States tended to be higher than yields in adjoining older States. But it does not appear that soil exhaustion was a major factor in the observed differences in yields. The modal difference in yields was about 11 percent. But differences among States for individual crops were highly variable. In 10 State-to-State comparisons, the average yield in the frontier State was lower than in the adjoining older State. Sugarcane yields in the frontier State of Maranhao were as much as 38 percent lower than in Ceara, a nearby older State. (Area planted to sugarcane grew more slowly than total crop area in both States during 1947-65, but the lag was greater in Ceara than in Maranhao.) At the other extreme, coffee yields in Mato Grosso were nearly 2.5 times the yield in Sao Paulo.

An average rate of soil exhaustion has not been determined for Brazil. The pure rate of change in crop yield was -0.1 percent a year. Other factors, such as insects and disease, might tend to cause

Table 51.--Brazil: Changes in livestock productivity, 1947-65

Product	: Annual rate of		Product	: Annual rate of		
	: change in yield			: change in yield		
	: Pure			: Gross		
	:			:		
	:	:		:	:	
	: - - Percent - -			: - - Percent - -		
	:	:		:	:	
Cattle	-0.4	-0.5	Milk	2/3.3	2/4.4	
Hogs	- .7	-1.3	Eggs	2/ .8	2/ .5	
Sheep	4.0	1/	Wool	2/ .2	1.8	
Goats	1.1	1.0	Total livestock			
Poultry	2/3.5	2/1.2	products	2.5	2/4.2	
Total meat	-0.7	-0.6	All livestock and			
			products	0.7	2/1.4	

1/ Not available. 2/ Growth rates for 1947-56 and 1957-59 differed significantly by F-test at the 5-percent level.

Source: (9).

Table 52.--Brazil: Changes in crop yields, specified crops, 1947-65

Product	Annual rate of change in yield			Product	Annual rate of change in yield		
	Gross	Pure	Gross		Pure		
	-- Percent --				-- Percent --		
Rice	1/0.2	1/0.1		Beans		-0.2	-0.5
Corn	1/.2	1/.2		Mandioca		1/.4	1/.2
Wheat	1/-1.2	1/-1.2		Sugarcane		1/.9	1/.5
Grain	2/	---		Coconuts		1/1.8	1/1.5
Peanuts	2.1	1.8		Other foods		1/.1	---
Soybeans	1/-1.2	1/-1.0		Total food crops		1/0.3	2/
Oilseeds	1/1.2	---		Cotton		1.2	1.0
Potatoes	1/1.5	1/1.3		Sisal		.3	1.8
Sweet potatoes	1.7	1.3		Jute		1.3	1.1
Tomatoes	2.9	2.2		Fibers		1.7	1.1
Onions	1/.9	1/.9		Coffee		0.5	-0.8
Vegetables	1.8	---		Tobacco		1/.4	-.1
Bananas	2/	-0.1		Cocoa		-2.4	-2.4
Oranges	1/-2.2	1/.3		Castorseed		.1	1/-0.8
Pineapples	1/.6	.8		Other nonfood		-.8	-.9
Grapes	.8	.9		Total 24 crops		0.1	-0.1
Fruits	.4	---					

1/ Growth rates for 1947-56 and 1957-65 differed significantly by F-test at the 5-percent level.

2/ Less than 0.05.

Source: (9).

yields to decline progressively. If these factors are ignored, -0.1 percent can be used as the estimated rate of soil exhaustion. In that case, the modal difference of 11 percent between level of yields in frontier States and yields in the older States would have required about 100 years to develop, assuming that the initial fertility was the same in both areas. The proportion of cropland in the older States that has been cropped for 100 years or more cannot be high. Cropland in Sao Paulo more than doubled between 1920 and 1940. This suggests, therefore, that at least half the cropland had been cropped for less than 30 years by the beginning of the period covered in the present study. At the assumed rate of -0.1 per-

cent, the fertility level of this land would have declined only between 1 and 2 percent. Thus, it appears that present differences in yields between new and old areas result more from differences in the inherent productivity of the virgin soils than from soil exhaustion.

Factors Complementary to Land

Other production requisites have been largely maintained in the proportions required by traditional techniques. Of these, labor is the most important. But capital requirements--even for traditional agriculture--are not trivial: shelter, tools, land clearing, and planting of tree

crops. The rate of formation of such capital largely determined the rate of growth on the frontier, which, as shown in table 49, was in the range of 8 to 11 percent a year.

Labor

Employment in agriculture increased about one-fourth between 1950 and 1960. This was only about half the size of the increase in agriculture output. The rural areas of the older States apparently supplied about 7 million migrants during the decade. Approximately 6 million went to urban areas and about 1 million to rural areas of frontier States. The outflow from rural areas was heaviest in the immediate hinterland of industrial areas. Rio de Janeiro and Espirito Santo had fewer farmworkers in 1960 than in 1950, despite increases in area of crops and numbers of livestock. In Sao Paulo and Minas Gerais, where rural areas felt strong pulls from both urban centers and adjoining frontier States, numbers of farmworkers increased only slightly. Farm employment in the frontier States of Parana and Maranhao, on the other hand, increased 110 percent and 94 percent, respectively.

Nationally, employment on farms increased at a compound annual rate of 2 percent a year between 1950 and 1960. Composite input of cropland and livestock numbers increased at the rate of 3.9 percent. Thus, labor productivity rose appreciably. Allowing for some increase in the proportions of more labor intensive crops and livestock, labor productivity appears to have increased about 55 percent.

Purchased Nonfarm Inputs

Fertilizer, machinery, and other purchased nonfarm inputs made up about

one-fourth of the value of all inputs used in farming in 1962-63. After tripling between 1950 and 1958, fertilizer consumption remained static at relatively low levels between 1958 and 1966, but rose sharply again in 1967. Total nutrients used per hectare averaged about 10 kilograms during the 1958-66 period. High prices of fertilizer and generally low response ratios seem to have held consumption in check, although opportunities for profitable use of fertilizer apparently have not been exploited fully. Farmers paid about 63 cents a kilogram for nitrogen in calcium nitrate in 1967, 29 cents for P_2O_5 , and 18 cents for K_2O . Use of plant protection materials increased from about 7,000 tons a year in 1957-59 to 22,000 tons a year in 1965-67.

Relatively little mechanical and animal power was used on Brazilian farms during the period under study. About three-fourths of the farms reported using only human power in 1960, including many large farms (one-fourth of those having 1,000 or more hectares of land in crops, for example). This basic difference between agriculture in Brazil and that in the United States or northern Europe has been a subject of concern to Brazil for a century and a half; during this time attempts to increase use of power have been unsuccessful. The number of farms reporting some mechanical power rose from about 6,000 in 1950 to 46,000 in 1960. But, with over 3 million farms, it is obvious that farmers are still using too little mechanical power to affect national labor productivity significantly. The number of tractors on farms increased from 8,000 in 1950 to 63,000 in 1960. Tractors are produced domestically, but demand has been weak and sales (production plus imports) insufficient to increase the stock of tractors appreciably. Power is used most extensively in the South. Sao Paulo and Rio Grande do Sul had 71 percent of

all tractors on farms in Brazil in 1960. Available census reports for 1960 do not include data on numbers of work animals, but a preliminary tabulation of the number of plows showed these two States also had 71 percent of Brazil's plows.

Brazil had 461,000 hectares of irrigated land in 1960, or less than 0.2 percent of total cropland. More than half of this irrigated area was used to grow rice in Rio Grande do Sul.

Total investment in Brazil's agriculture about doubled between 1950 and 1965, a rate of growth only slightly greater than that of agricultural output. The most rapidly growing component was machinery and equipment, which made up about one-fifth of the total investment in 1965. Capital formation was largely out of farmers' own savings, or noninstitutional investment, since annual loans to agriculture by the Bank of Brazil were generally about 10 percent of the value of agricultural output, and were mostly for periods of less than 1 year. Annual capital formation, on the other hand, was about one-fifth to one-fourth as large as annual agricultural output.

DEMAND AND PRICES

Prices of agricultural products in Brazil during the past 20 years have been subject to numerous influences. Some commodities, like coffee and sugar, were dominated by world markets and by marketing boards with considerable power over marketing and distribution of returns to producers. Some important items of domestic consumption--milk and beef, for example--were controlled for a while to check the rising cost of living. For the most part, however, agricultural prices were relatively free to respond to market forces. Since the overall supply increased about in line with domestic demand, as

already noted, the agricultural price level did not diverge markedly from the general wholesale price level.

Although the national farm-nonfarm price ratio was relatively stable during 1947-65, there was substantial geographic variation. In the Northeast, prices rose sharply, relative to the national average, probably reflecting increased consumer purchasing power generated by activities of the regional development authority (SUDENE). The offsetting declines were in areas close to the urban centers of the South.

Expanding production on the frontier increased the influence of transportation on the derived demand confronting the farmer. Lengthening distances tend to depress prices at the frontier, but the degree of disadvantage decreases with improvements in transportation. Increased efficiency reduces transportation costs per mile. With declining freight rates, prices at distant markets tend to rise, whereas prices at points closer to the central markets tend to fall.

Brazil's highway system was expanded greatly during the 1950's and 1960's. Length of paved highway rose from 3,133 kilometers in 1955 to 26,546 kilometers in 1965. In 1968 alone, more highway was paved than was in existence in 1955. Secondary road construction will be an important factor in future agricultural development. It would take 60 years, building as many kilometers of road each year as were built from 1955 to 1965, to bring the frontier States up to Parana's 1965 average--350 kilometers of road per 1,000 square kilometers of land area.

Industries processing agricultural raw materials contributed some of the increase in demand stimulating the growth

of agricultural output. Oilseeds--peanuts and soybeans--have been among the fastest growing crops, and the basis for an equally fast-growing oilseed crushing, refining, and processing industry. Locating marketing facilities properly for a dynamic agriculture has been a major problem.

Brazil continues as a regular supplier of coffee, cocoa, sugar, and cotton to world markets. Its expanding agricultural capacity is beginning to be felt in other commodity markets--rice, corn, soybeans, and peanuts. However, it is likely that the proportion of Brazil's total output of these latter crops sold abroad will continue small, on the average, for many years. Given a continuation of the past year-to-year variability in production, exports are also likely to be sporadic and highly variable. Net prices to exporters may be adversely affected by the inability to assure buyers a dependable supply. Also, the lower average utilization of export facilities means higher marketing costs and wider margins between c.i.f. returns and returns to producers until a more stable year-to-year level of exports can be sustained.

AGRICULTURAL FINANCE

Brazil has been evolving a credit system for agriculture since 1937, but institutional credit was equivalent to only 10-12 percent of the value of agricultural production as recently as 1967. Inflation, high interest rates, and the need to control credit supplies all tended to restrict use of credit by farmers. Mortgage lending, in particular, has been virtually nonexistent. This deficiency handicaps small farmers in their efforts to acquire property, or to build up units of a size appropriate for rising labor productivity. Organized land development programs, public and private, have satisfied some of the demand for land. Private land develop-

ment companies figured importantly in the spectacular development of Paraná.

TECHNOLOGY

Brazilians have long been aware that their agricultural technology lags behind much of Europe, North America, and Oceania. Some progress has been made in overcoming this gap, but much remains to be done. A network of agricultural experiment stations employs about 900 scientists. Farmers are being taught improved practices through quasi-public associations for credit and rural assistance (the ABCAR system), but only about a third of the municipios were served by the system in 1967. Progress is handicapped by lack of education in rural areas. Half the rural children 7 to 14 years old did not attend school in 1964. Vocational agricultural schools were almost nonexistent, and universities had only 8,000 agricultural and veterinary science students in 1968. Brazilian farmers appear to be receptive to profitable innovations, in view of their rapid adoption of new crops such as peanuts and soybeans, and the results of detailed studies of agricultural innovation in selected areas.

FUTURE DEVELOPMENT

Brazil has perhaps the widest range of options for future agricultural development of any country in the world. Average performance on most measures of productivity is low, suggesting that large gains from improvement in technology may be possible. At the same time, there is much land available for settlement in the frontier States.

Since World War II, there have been small gains in productivity (more in labor productivity than in crop yields). Most of the output gains were due to increases in crop area and livestock num-

bers. Brazil was able to feed a growing population at relatively stable prices, while increasing its agricultural exports slightly. Brazilian experience, therefore, demonstrates the potential strength of spontaneous development, given an increasing labor force and available land onto which to expand.

Technological progress was slow in Brazilian agriculture during the 1950's and 1960's. Positive steps were taken to improve the technological base and to disseminate information about improved methods. But the effort was small relative to the size of the task. Agricultural input industries were established to provide domestic supplies of tractors, fertilizers, and plant protection materials, although prices of such supplies remained high relative to product prices. Instances of rapid adoption of new techniques occurred during the 1947-65 period. Soybeans were introduced and output increased 20 percent a year. Cotton yields in Sao Paulo and Parana increased 4.3 and 3 percent annually as a result of improved varieties and cultural practices. In the late 1960's, there were indications that the pace of adoption of new techniques may have increased. Yet, the slow rate of technological progress in agriculture remains a major challenge.

Future development of Brazilian agriculture probably will continue to reflect the ready availability of labor. Frontier areas will afford employment to workers unable to obtain nonfarm employment. Surplus farmworkers from older areas may provide their own minimal capital needs, and contribute to further capital formation by investing their own labor, or wealthier investors may develop frontier properties as an alternative to intensifying capital inputs on older farmland. Mobility of agricultural labor and capital was an important feature of

Brazil's development in the 1947-65 period. Therefore, if new techniques are to be adopted in older areas they must assure marginal returns to capital at least equal to those which investors may expect to earn from investments on the frontier.

Expansion of agriculture into new areas requires new roads, marketing facilities, and public services such as education, health, and public safety. Since the amount of investment required (except for roads) is more closely related to the growth of population rather than to its geographic distribution, investment requirements for growth on the extensive margin (the frontier) may not differ greatly from those required for an equal increase in output on the intensive margin (new techniques applied in old farming areas).

Difficult adjustments may be required in Brazilian agriculture as development proceeds. Landowners in the hinterland of the major industrial centers have been unable to maintain labor forces at former levels. These areas have tended to shift either to enterprises requiring less labor or to labor-intensive enterprises (truck crops, milk, and eggs) which have a comparative advantage near urban markets. On the other hand, population pressures in some rural areas (the Northeast, and older colonial areas of the South) have tended to depress labor productivity and per capita incomes. Facilitating migration from such areas to urban or agricultural frontier labor markets would raise productivity, but would force a restructuring of agriculture. The various forces contributing to increased labor productivity will likely alter the optimum size of farm unit. The potential benefits of abundant land and modern farming methods may be more easily achieved if steps are taken to facilitate desirable adjustments in land ownership and control.

Chapter X. INDIA: SLOW AND RAPID GROWTH

By W. E. Hendrix

BACKGROUND

India is the world's seventh largest nation in land area and the second largest in population. At the time of its independence in 1947, it was still a loosely knit mosaic of former British provinces and 540 princely or "native" states. The latter differed widely in size, degree of autonomy, and governing patterns.

India has been predominantly agricultural throughout its known history. In 1947, roughly 75 percent of its population of 350 million depended on agriculture as their main source of employment. Most of these people lived in villages which were highly self-contained social and economic units composed of a variety of occupations and interests--farmers, herdsmen, agricultural laborers, land-owners, moneylenders, artisans, traders, village officials, teachers, and religious leaders.

For centuries, the dominant concern of India's masses centered on the problems of sheer physical survival. Severe droughts and floods recurred frequently, resulting in widespread famine and starvation for large numbers of people. Epidemics of smallpox, cholera, typhoid, and other dread diseases were common, sometimes virtually depopulating whole villages and regions. In earlier centuries, many parts of India repeatedly suffered the ravages of war brought on by foreign invaders or internal rivals.

Age-old concern with these and other problems of survival left a deep imprint upon India's masses. Centuries of depriva-

tion affected their hopes, expectations, fears, and group loyalties, as well as their institutions, beliefs, and values. Accordingly, India's rural people--among the world's most impoverished, largely illiterate, and little aware of life outside their own and nearby villages--had no experience with, and little awareness of, the possibility of sustained human progress.

When independence came in 1947, there were roughly 70 million farm units in India. Most of these had only 2 to 5 acres of cultivatable land. Crops accounted for more than four-fifths of agricultural output. India's agriculture, except for a few small enclaves producing export crops like tea and spices, was highly traditional in three important respects: (1) It was pre-scientific, having changed little in many generations. (2) It was pre-market or carried on mainly for internal village consumption. (Farmers limited marketing to the small residuals above their household needs after payments in kind had been made to village laborers, moneylenders, officials, artisans, and others contributing to agricultural output and to the maintenance and continuity of village life.) (3) Custom, tradition, and authority had long been the sources of its allocative and distributive directives.

India's agriculture was traditionally highly static, not only in technology and organization but also in its aggregative level of production. Food grain output varied little from one decade to another during the first half of the 20th century, but it increased 2 million tons a year

from 1949/50 to 1964/65 (fig. 29). Per capita output of all agricultural commodities had been declining for more than two decades.

In 1947, India had yet to develop:

(1) economical sources of supply and distribution systems for modern farm inputs; (2) a rapidly growing nonfarm sector as a market or demand basis for sustained increases in production beyond those needed to meet farmer's consumption needs; (3) modern transport and marketing facilities and services needed for linking farmers more closely to nonfarm markets; and (4) strong research, education, extension, credit, and other institutions of the kinds required for a rapidly growing and highly dynamic agriculture.

One of India's principal assets--capable of sparking a sustained drive for economic progress--was a relatively small body of well-educated leaders. Most of these men were closely associated with government, but some were in educational, trade, manufacturing, and professional fields. Many had studied and lived in economically advanced nations. They were, therefore, keenly aware of India's economic backwardness and of the need to increase per capita output and levels of living and to eradicate the widespread poverty.

India's agricultural development since the early 1950's can be divided into two major time periods based upon (1) the nation's development policies and programs, and (2) the effectiveness of

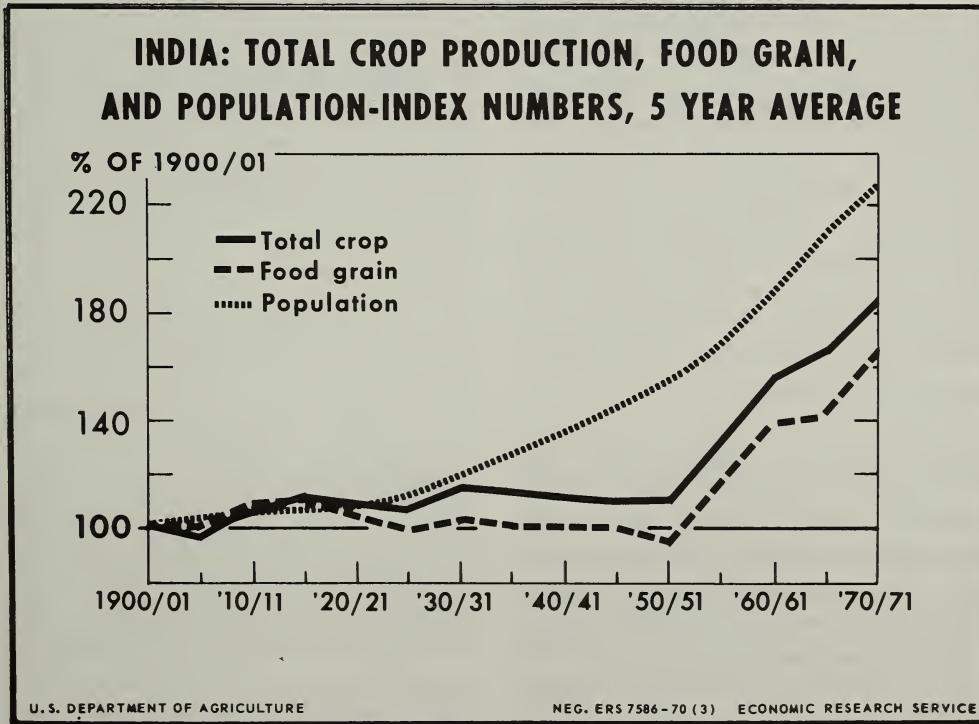


Figure 29

these programs in increasing output. The former period ended in 1964/65; the latter began in 1965/66.

MAJOR APPROACHES TO IMPROVING AGRICULTURE

In the first few years following independence, many of India's agricultural leaders were optimistic about prospects for achieving rapid increases in agricultural production. India's farmers had hardly begun to use chemical fertilizers, pesticides, improved crop varieties, and other modern inputs that had increased production in more developed nations. Other opportunities for increasing output appeared to lie in fuller development and use of India's natural resources, including its potentials for irrigation and multiple cropping (growing two or more crops per year on the same land), and its abundant labor resources.

Closing the technological gap appeared to offer a relatively cheap source of large increases in agricultural output that could be quickly achieved with considerable benefit to the nation's general economic growth objectives. This goal, therefore, was given top priority in India's early agricultural development strategies. Exploiting as fully as possible already known ways to increase production was expected to help generate public support and provide a revenue base for financing research institutions.

Closing the technological gap was viewed as a twofold problem: educating and motivating the farmers to accept innovations and providing the means to effect them. Heavy emphasis was placed on the building up of community development and agricultural extension programs and the strengthening of cooperatives to handle the local distribution of the requisite inputs and credit.

The strengthening of agricultural colleges and universities was recognized as a longer run essential for improving the quality of community development and the competence of extension and research personnel. But development of educational and research institutions was viewed as a major longrun task that could not be wisely undertaken without a careful evaluation of the nation's needs and the experiences of other countries.

Various kinds of land reform measures (including abolition of zamindars, limitations on size of landholdings, and limited experimentation with cooperative systems of farming) were undertaken to free farmer initiatives and to provide larger production incentives.^{18/} Policies bearing on the prices of inputs other than land and of farm products were given little attention beyond enunciating the objective of stabilizing prices and terms of trade between agriculture and rest of the economy at early 1950 levels.

U.S. financial and technical assistance had an important role in India's agricultural development programs starting in the early 1950's. The first agreement providing U.S. financial and technical assistance for agriculture in India was signed in January 1952. The United States began by supplying agricultural extension workers to help close the technological gap. Under this first agreement, the United States also provided 75,000 tons of ammonium sulfate and small amounts of other fertilizer materials for use by the Indian Agricultural Research Institute (IARI) in field trials in many different parts of India. In addition, the services of a U.S. soil scientist were provided to work with IARI in the planning and conduct of this

^{18/} Zamindars were collectors of land revenue for the state who possessed considerable control of the land under their domain.

research. Later, the United States supplied funds for setting up 16 soil research laboratories.

In 1955, at the suggestion of the U.S. foreign assistance mission to India, an Indo-American team composed of outstanding agricultural leaders of both countries began an intensive review of India's agricultural research and education facilities and needs. This team recommended development of agricultural universities combining research, resident teaching, and extension patterned after U.S. land-grant colleges. Such universities have now been established in eight States, with assistance from the Agency for International Development and predecessor agencies in providing organizational and administrative skills, foreign exchange for laboratory and library facilities, and U.S.-owned rupees from Public Law 480 imports for building construction. The United States has also provided funds to Indian university personnel for advanced study in the United States and other countries. Although developed too late to have had much impact upon India's agriculture in the 1950's and early 1960's, these universities are becoming increasingly important in India's agricultural development.

CROP OUTPUT GROWTH, 1949/50 TO 1964/65

India's Overall Record

The extent to which views concerning the technological gap were correct can be gauged by India's progress in the 1950's and early 1960's. However, as shown later, the nation's agricultural price, procurement, and distribution policies inhibited both full realization and expansion of its agricultural production potentials.

From 1949/50 to 1964/65, India's total crop output increased at an annual compound rate of 3.2 percent. This was 0.7 percent a year above the population growth rate. Output of food grains increased nearly 30 million tons from the 1949/50 base of about 60 million tons; production of oilseeds, excluding cottonseed, rose 3.2 million tons from a base of nearly 5.3 million tons; combined output of cotton and jute climbed 5.8 million (180-kilogram) bales from a base of 5.9 million bales; and sugarcane (gur) doubled its base of 6 million tons. Comparable increases were achieved for most of India's crops.

As a result of the vagaries of its monsoon climate, India's food crop output varied considerably from year to year (fig. 30). Otherwise, India's crop output followed roughly a straight line from 1949/50 to 1964/65, indicating nearly equal annual increments to increases in output but a steadily declining rate of growth in total crop output. Annual food grain increments declined somewhat in the latter half of the period, but were offset in part by increasing increments of other crops.

State and District Differences

Crop output indexes for the years 1952/53 to 1964/65 reveal that India's States differed widely in their contributions to the nation's growth of crop output (table 53). Punjab, Gujarat, and Madras each had growth rates in excess of 4 percent a year. Three States, Assam, Uttar Pradesh and West Bengal, had growth rates of less than 2 percent. Output of food grains exceeded population growth in seven States containing roughly half of India's population; in eight States population growth surpassed food grain output.

INDIA: TOTAL CROP PRODUCTION, FOOD GRAIN PRODUCTION, AND POPULATION

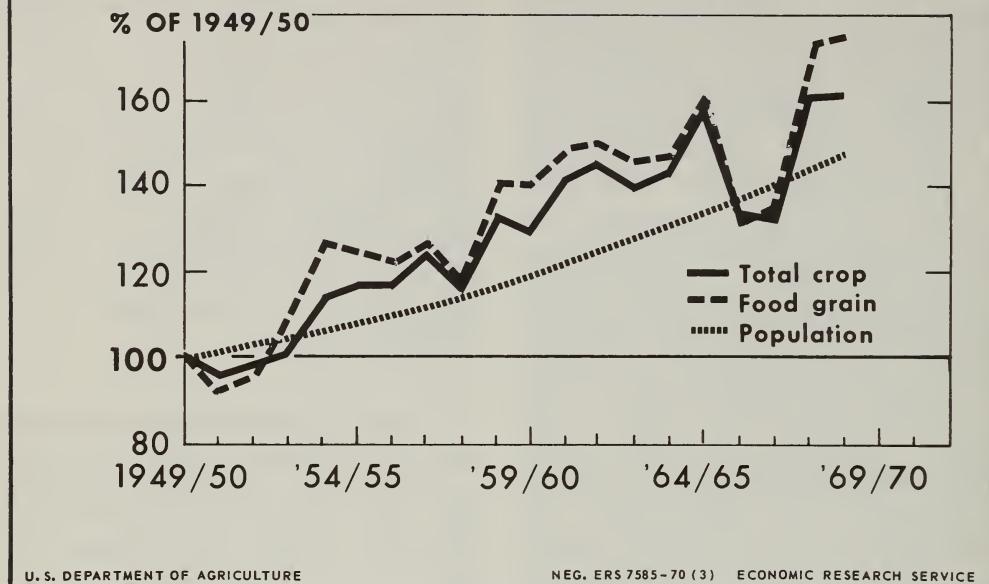


Figure 30

Crop output growth rates for the period 1952/53 through 1964/65 were computed for districts in a rapid-growth state and a slow-growth state in two major regions: (1) Punjab and Uttar Pradesh (lying mainly in the Indo-Gangetic Plains of north India), and (2) Madras and Orissa (located in the south and southeastern rice-growing region). In rates of growth in crop output, districts differed far more from their respective State averages than the States varied from the national average. The output growth rate of a few districts in each of four States has been remarkably high. Notable examples are those of Bhatinda (7.85 percent), Patiala (7.75 percent), and Hissar (6.94 percent) in the State of Punjab; Nainital district (5.51 percent) in Uttar Pradesh; Ramanathapuram (6.25 percent) and North Arcot (5.30 percent)

in Madras; and Kalahandi (6.57 percent) and Ganjam (4.91 percent) in the State of Orissa.

Crop Output Growth Relative to Needs

While several of India's States failed to increase crop production as fast as population, the nation as a whole succeeded in increasing its per capita agricultural production about 0.7 percent per year from 1949/50 to 1964/65.

This progress has been obscured in part by India's worsening chronic food shortages. The anomaly of growing food shortages paralleling increases in per capita production has been a result not of "the stork outrunning the plow" but of two other important factors. The first is

Table 53.--India and 15 States: Annual compound rates of growth in crop output and population, 1952/53 to 1964/65

State	Growth rates	
	All crop output	Population 1/
- - - - <u>Percent</u> - - - -		
Punjab 2/	4.56	2.61
Gujarat	4.55	2.61
Madras	4.17	1.25
Mysore	3.54	2.08
Himachal Pradesh	3.39	2.22
Bihar	2.97	2.12
Maharashtra	2.93	2.32
Rajasthan	2.74	2.68
Andhra Pradesh	2.71	1.63
Madhya Pradesh	2.49	2.51
Orissa	2.48	2.16
Kerala	2.27	2.33
West Bengal	1.94	2.92
Uttar Pradesh	1.66	1.84
Assam	1.17	3.15
India	3.01	2.19

1/ 1951-61. India's population growth for 1951-65 is now estimated to have been at the rate of 2.5 percent per year. 2/ Punjab as constituted in January 1966.

Source: (46).

growth in per capita demand for food resulting from increases in per capita income generated by India's small but nevertheless growing prosperity. The second is the adoption of policies to insure a more equitable distribution of food to the many Indians lacking enough money to buy food in the open market. India's demand for food grains increased 3.85 percent a year as the result of population growth of 2.5 percent a year, while per capita income increased 1.8 percent a year (with an assumed income elasticity of demand for food grains estimated at 0.75). Demand for farm-produced raw materials increased at an annual rate of 5.7 percent.

The adverse effects of this growing disparity between food grain output and demand were alleviated by food imports under U.S. agricultural commodity aid programs. The fact remains, however, that India's failure to increase its output of food and farm-produced raw materials at rates matching growth in its needs had a substantial effect on its overall economic growth. Large concessional imports (used in part to stabilize the price of food for urban consumers) helped hold food grain prices below the incentive levels they would have otherwise reached. This inhibited incentives to use more fertilizers, water, pesticides and other highly productive inputs. At the same

time, growing economic scarcity of both food and farm-produced raw materials led to rising costs of production in nonfarm sectors.

Although previously discernible, these consequences were brought into particularly sharp focus in 1965/66 and 1966/67, when an abrupt decline in agricultural production caused by drought brought growth in the nation's whole economy to a sudden halt. Food shortages required rationing of food grains in urban areas, a large increase in the number and geographic distribution of "fair-price shops" for retail food sales, and reduction in agriculturally related industries.

Agriculture is India's most important industry. It still supplies employment for 70 percent of India's total labor force; nearly half of its gross domestic output; raw materials for half of its industrial output; markets for nearly half of its total production; and roughly three-fourths of its foreign exchange earnings. Even with rapid rates of growth in the nation's nonagricultural sectors, over half of India's labor force

will still be in agriculture until at least the year 2000. Accordingly, India's economic development will continue for several decades to be heavily dependent upon increasing the productivity of its farms. However, agriculture will become increasingly dependent upon other sectors of the economy to supply inputs and consumer goods, to serve as markets for the increasing farm output, and to provide employment for the surplus of farm labor.

MAJOR SOURCES OF CROP OUTPUT

GROWTH, 1949/50 TO 1964/65

Area, Yield, and Crop Changes

Breakdown of India's rate of growth by major sources for 1952/53 to 1964/65 reveals that increased crop area accounted for 40.6 percent; higher crop yields, 37.7 percent; changes in crop combinations, 15.8 percent; and interaction among these sources, 5.9 percent (table 54). Reductions in area under fallow and use of "cultivable waste lands" were the major sources of increase

Table 54.--India: Major sources of crop output growth, 1952/53 to 1964/65

Source of growth	Annual growth rate by source	Percentage distribution
- - - - <u>Percent</u> - - - -		
Increase in crop area	1.2	40.6
Increase in crop yields	1.1	37.7
Crop pattern changes	.5	15.8
Interaction	.2	5.9
Total	3.0	100.0

Source: Computations based on Indian Government statistical publications.

in crop area. Increases in the use of cropland for two or more crops per year ranked third in importance as a source of increased crop area.

Crop output growth rates were analyzed by major sources for each of India's States and for each district in four States--Punjab, Uttar Pradesh, Madras, and Orissa. These data reveal large differences between States and among districts within States in the relative importance of area, yield increases, and crop pattern changes as sources of growth in crop output. Generally, however, in high-growth States and districts, increases in area, yields, and crop pattern changes were all important contributors to crop output growth (table 55).

Input Basis of Crop Output Growth

The above breakdown in sources of crop output growth shows the importance of land inputs. An attempt also has been made to estimate the contributions of increases in fertilizer and water inputs (table 56). The residual of the output growth not accounted for by these three major inputs is assumed to have resulted from increases in all other inputs (including the use of improved crop varieties, pesticides, more intensive application of labor and bullock power, and improvement in management practices). For these purposes, a simple estimating model was used. For food grains, it was assumed that yields would increase 10 kilograms per kilogram of fertilizer and that irrigation would increase output 250 kilograms per hectare. Comparable percentage increases in yields were assumed for other crops. Because of the very limited use of fertilizers in India (only 66,000 tons in 1952/53) and the lack of data on the distribution of these fertilizers, a zero

rate of fertilizer use in 1952/53 was assumed for States and districts. This assumption was approximately correct for all States except Kerala.

On the basis of this estimating model, increases of 15 percent in land inputs and proportionate increases in fertilizers, water, and all other inputs accounted for 38 percent of India's growth in crop output from 1952/53 through 1964/65. Heavier fertilizer applications per hectare accounted for 18 percent of the increase; improvement in the ratio of irrigated to nonirrigated crop area accounted for 9 percent, leaving 35 percent of the total crop output growth rate as a product of more intensive use of other inputs. Expressed in another way, assuming this model, if only land, fertilizer, and water inputs had been increased, there would have been a 27-percent increase in crop output, compared with a realized 41-percent increase from all input increments. The application of this estimating model to States and districts reveals close correlation between (1) the estimated yield increases contributed by fertilizers and water combined, and (2) the achieved increases in output per unit of land, with fertilizer increases more important in some cases and water in others.

More precise information on the input bases of growth in crop output in the Punjab (as constituted in January 1965) is available as a fortunate byproduct of detailed and fairly dependable data on stocks of capital collected by the Punjab government for the years 1950/51, 1955/56, 1960/61, and 1964/65 (table 57). The more salient points can be summarized as follows:

1. Stock of fixed capital in Punjab agriculture has grown considerably since 1950/51.

Table 55.--India: Compound rate of growth in crop output, area, and yield by crops, 1949/50 to 1964/65

Crop	Output	Area	Yield per hectare
- - - - <u>Percent</u> - - - -			
Food grains:			
Cereals:			
Rice	3.37	1.26	2.09
Jowar	2.50	.91	1.58
Bajra	2.23	1.01	1.20
Maize	3.79	2.63	1.13
Ragi	2.80	.53	2.26
Wheat	3.97	2.70	1.24
Barley	- .29	- .65	.37
All cereals	3.16	1.22	<u>1/1.92</u>
Pulses			
	1.62	1.87	- .24
All food grains	2.98	1.34	<u>1/1.61</u>
Nonfood grains:			
Oilseeds:			
Groundnuts	4.18	3.81	0.36
Sesamum	- .52	.15	- .68
Rapeseed and mustard	3.16	2.86	.29
All oilseeds	3.20	2.55	<u>1/0.64</u>
Fibers:			
Cotton	4.44	2.42	1.97
Jute	3.54	3.01	.52
All fibers	4.37	2.52	<u>1/1.81</u>
Nonfood grains:			
Sugarcane	4.59	3.26	1.29
Tea	2.01	.52	1.48
Coffee	8.48	2.18	6.17
Tobacco	2.69	1.78	.90
All nonfood grains	3.61	2.52	<u>1/1.06</u>
All crops	3.19	1.55	<u>1/1.60</u>

1/ The yield estimates for crop groups reflect the influence of changes in crop patterns, crop location shifts, and interaction between these factors as well as pure yield increases.

Source: (46).

Table 56.--India and 14 States: Increases in crop output and estimates of increases in crop output by sources, 1952/53 to 1964/65

State	Increase in crop output	Sources of increases in total crop output				
		Increase in crop area 1/	Increase in crop output per hectare	Increase in fertilizer	Increase in irrigation	Increases in other inputs
						Percent - - -
Punjab	66.7	24.7	42.0	10.5	8.5	23.0
Gujarat	61.4	5.5	55.9	18.3	9.2	28.4
Madras	58.9	13.5	45.4	17.8	6.0	21.6
Mysore	48.7	10.0	38.7	9.5	3.8	25.4
Bihar	38.5	8.5	30.0	3.7	4.9	21.4
Maharashtra	38.3	5.3	33.0	10.0	4.7	18.3
Rajasthan	37.0	38.8	- 1.8	2.3	5.0	2/
Andhra Pradesh	36.7	3.3	33.4	12.1	7.5	13.8
Madhya Pradesh	33.5	16.2	17.3	3.8	1.6	11.8
Orissa	32.6	10.1	22.5	2.5	4.1	15.9
Kerala	30.2	16.5	13.7	9.6	1.7	2.4
West Bengal	24.8	7.2	17.6	5.6	2.6	9.4
Uttar Pradesh	21.8	8.9	12.9	2.9	1.6	8.4
Assam	15.0	15.8	- .8	1.1	.2	2/
India	41.0	15.3	25.7	7.5	3.8	14.4

1/ Estimates include effects of increased use of fertilizer, irrigation, and other inputs on the increased crop area. 2/ Negative values indicate a decrease in quality of land and other inputs.

Source: Computations based on statistical publications of the Government of India.

Table 57.--Punjab: Estimates of value of specified agricultural inputs and ratio of traditional to nontraditional inputs in agriculture, 1950/51 to 1964/65

Item	(At 1950/51 prices)			
	1950/51	1955/56	1960/61	1964/65
Value :				
: - - - - <u>1,000 rupees</u> - - - -				
Seeds	192,529	227,193	232,497	241,790
Manures	41,020	48,405	49,535	51,515
Fuel oil	2,148	6,593	10,636	33,097
Electricity	382	8,049	10,326	27,261
Fertilizer	1,651	11,120	15,282	120,950
Land services	24,018	25,419	26,149	27,000
Water	52,003	63,300	67,210	77,763
Miscellaneous	4,996	5,896	6,033	6,275
Total	318,750	395,978	417,722	585,654
: - - - - <u>Ratio</u> - - - -				
Ratio of nontraditional to traditional inputs 1/	0.21	0.29	0.33	0.79

1/ Seeds, manures, land services, and miscellaneous items are classified as traditional inputs and the other inputs are classified as nontraditional inputs in the calculation of these ratios.

Sources: (72, 73, and 74).

2. Composition of fixed capital, however, has been changing. The proportion of nontraditional assets increased from 3 percent of the total in 1950/51 to 15 percent in 1964/65. However, weight of traditional inputs is still heavy in total stocks.
3. Inputs of fixed capital (as distinct from stocks) increased in the same manner as stocks.
4. Working capital increased greatly. This suggests important technological changes. The share represented by fertilizers, water, electricity, and fuel oil increased significantly.
5. The absolute amount of capital from farm sources increased perceptibly; so has employment of labor and land.

6. Productivity of capital, both traditional and nontraditional kinds (inferable from the Punjab's rapid rate of growth in crop output), appears to have been large.

Data for Gujarat and Madras (ranking second and third, respectively, after the Punjab in growth rate of crop output) suggest a somewhat similar pattern of development. There were substantial increases in a mix of highly complementary modern inputs like fertilizers, water, and improved implements. These were associated in turn with increasing employment of such traditional inputs as land, labor, and cattle for power. It is noteworthy that in each of these three States manufacturing and trade grew appreciably. All placed considerable emphasis on enterprises highly complementary to agriculture.

NATURE OF CONSTRAINTS ON OUTPUT GROWTH

As indicated in the preceding section, changes and regional differences in rates of change in agricultural output from the early 1950's through 1964/65 can be accounted for by increases in inputs of land, water, fertilizers, and other factors of production and by regional differences in such input increments. Explaining output changes and differences in terms of their input bases, however, leaves unanswered the question of why even larger input increments to increase production were not made and why States and districts differed so widely in their use of inputs. It also provides little insight into the size of the nation's unexploited agricultural production potentials. Nor does it help identify the kinds of policies and programs needed for a closer matching of performance and potentials.

To aid in answering these questions, this section indicates the nature of the major factors operating as constraints on the uses of inputs from 1949/50 to 1964/65, noting, first, those operating on the side of supply and, second, those growing out of demand and price relations.

Land Inputs

India is frequently depicted as a very densely populated nation rapidly running out of land. However, in 1964/65, India had 20.3 million hectares of cultivatable land under fallow and 17.4 million hectares classified as cultivatable waste, compared with a total of 137.9 million hectares used for crops. Area used for crops increased from 126.8 million hectares in 1952/53 to 137.9 million hectares in 1964/65.

In addition to using additional land, planting two or more crops per year on the same land is an important source of additional land inputs which the nation has hardly begun to exploit. In 1964/65, only 15 percent of India's total cropland and 15 percent of its irrigated cropland were used for multiple cropping. Yet, in much of India, two or more crops a year can be grown on the same land if moisture is adequate.

Water Inputs

Irrigation has been used for many centuries in Indian agriculture. It is essential for crop production in low rainfall areas during normally dry seasons, and for insurance against crop failures in areas subject to frequent monsoon failures. Recent estimates of India's stream and ground water resources indicate a potential to irrigate about 75 million hectares (75). This is little more than half the crop area in 1964/65.

The gross sown area irrigated increased from 21.1 million hectares in 1952/53 to 26.1 million hectares in 1964/65 (table 58). While this was a significant increase, the fact remains that it is not the lack of water resources which has limited irrigation. India could develop more fully its water resource potentials, and farmers could make fuller use of the potentials already developed.

The extent to which farmers have failed to use developed potentials cannot be estimated from currently available data. It is known, however, that in the past many farmers used limited irrigation, or none, where developed supplies would have permitted much larger uses of water. Some observers attribute such failures to the low economic aspirations of the farmers. This view, however, cannot be sustained without first carefully considering water costs, farm product prices, and yield responses to irrigation water.

As stated earlier, physical limitations of water were not a major constraint to increasing India's agricultural production during this period. If improved crop varieties and other complementary inputs had been available and if price relationships between farm products and water had been more favorable, India's farmers would likely have increased their uses of water by much larger amounts.

Fertilizers

Fertilizer supplies to India's farmers have been small, compared with those provided in Japan, Taiwan, and many other countries. However, until after 1964/65, the demand for fertilizers, rather than the available or potentially available supply, appears to have been the main constraint to their use. Lack of delivery at the right places and times has sometimes been an additional factor limiting fertilizer use.

Table 58.--India: Gross sown area irrigated by sources of water, 1952/53 and 1964/65

Source of water	:	1952/53	:	1964/65
:----- <u>1,000 hectares</u> -----:				
Canals:				
Government	:	7,511		9,951
Private	:	1,350		855
Total	:	8,861		10,806
:-----				
Tanks	:	3,303		4,755
Wells	:	6,521		8,021
Other sources	:	2,437		2,482
Total	:	21,122		26,062
:-----				

Source: Data provided by Directorate of Economics and Statistics, Ministry of Food, Agriculture, Community Development and Cooperation, Government of India, New Delhi.

Labor Inputs

India has an abundance of labor--a large component of total inputs in agricultural production--relative to its land and capital resources. If the marginal productivity of labor in India were zero, (that is, if additional labor would not increase output), there would be no reason to increase labor inputs. The assumption of zero marginal productivity of labor in India, however, appears questionable if for no other reason than that land and other resources are available to enlarge the nation's agricultural plant even within traditional patterns of organization. However, limits in the supply of labor are unlikely to constrain agricultural production in India for a long time to come.

Adaptable Technologies

India's gains in agricultural production from the early 1950's through 1964/65 were achieved with few improvements in adaptable farm technologies, except better crop varieties. Initially, India's own agricultural leaders (as well as its foreign agricultural advisors) had expected to achieve large increases in agricultural output merely by closing a large technological gap. Production gains, they reasoned, could be readily achieved by adopting technology from India's best farms and from economically advanced nations. But yields of improved crop varieties introduced into India during the 1950's were only about 10 percent higher than traditional varieties. Such increases from traditionally low yield bases were too small to provide an effective demonstration of value, since yield variations are normally much larger as a result of year-to-year weather differences.

DEMAND AND PRICE RELATIONS

From 1949/50 through 1964/65, India's demand for farm-produced food

and raw material resulting from growth in population and per capita incomes increased at an annual compound rate of about 4 percent a year. At the same time, total agricultural output increased 3.2 percent a year, while output of food grains increased 3 percent per year. It appears, therefore, that demand limitations have not constrained growth in agricultural output.

India's growth in demand, however, has not resulted in corresponding shifts in terms of trade between farmers and the rest of the economy, although such price shifts are the only signals of changes in demand that are meaningful to farmers in a free market. There was no discernible trend in prices in favor of agriculture until 1965 (table 59). Within agriculture, however, prices of nonfood grain crops relative to nonfarm prices moved upward while those for food grains trended downward with larger imports. In turn, an increasing percentage of agricultural resources was allocated to nonfood grains, reflecting the economic rationality of farmers in the absence of shifts in supply or costs.

This relative stability of food grain prices attests to successes in achieving the price policy objective enunciated in India's First Five-Year Plan. These successes were achieved in part by the nation's internal food grain procurement and distribution policies. However, concessional food imports available under the U.S. food aid programs were the principal means of equilibrating aggregate supply and demand while maintaining a relatively stable level of food grain prices. If freely fluctuating prices had been substituted as the supply-demand equilibrating mechanism, food grain prices in 1963/64 would have been 25 to 35 percent higher. The exact level would have depended on income and price elasticities of demand.

Table 59.—India: Indexes of wholesale prices of all commodities and of specified groups of commodities, 1953-66

Year	(1951=100)						
	All commodities	Agricultural commodities	Food grains	Sugar and gur	Food articles	Industrial raw materials	Manufactures
1953	105.5	108.0	108.0	78.2	98.7	108.3	115.6
1954	93.6	96.2	102.5	78.7	94.8	83.9	95.8
1955	87.2	85.7	80.5	72.4	84.1	78.0	97.5
1956	82.7	80.0	77.6	55.9	77.0	75.7	96.6
1957	94.2	95.0	99.3	61.5	90.9	88.8	103.0
1958	97.0	97.6	103.6	67.9	94.7	89.1	104.7
1959	101.0	103.6	112.8	79.8	102.4	88.4	105.0
1960	104.7	105.9	108.5	92.3	105.8	94.6	108.2
1961	111.7	112.5	108.6	83.4	106.7	111.2	120.1
1962	111.9	111.7	106.6	75.1	106.8	109.1	122.7
1963	114.4	112.1	112.0	91.0	112.1	104.4	124.8
1964	123.0	119.5	123.2	118.5	121.6	106.7	127.0
1965	136.6	141.6	152.9	118.1	142.1	124.5	133.0
1966	147.7	154.0	159.8	99.4	150.0	144.7	144.6

If it is assumed that India's farmers act in a rational economic manner, then it follows that their failure to increase food grain production at rates matching demand resulted from the nation's food grain pricing procurement and distribution policies, together with rather low realized yield increases from improved practices, rather than from limitations in available supplies of land, water, fertilizers, and other inputs.

This conclusion may seem questionable. Despite such procurement and distribution policies, some States and some districts within both slow and rapid-growth States did achieve remarkably high rates of output growth in the 1952/53 to 1964/65 period.

High rates of growth in a few States may be accounted for by differences among States in natural resource endowments and in policies pertaining to the allocation of inputs, such as fertilizers. The former has some validity when applied to differences among States and especially when applied to differences among districts within States. However, differences in allocation of strategic inputs do not appear to have been important in accounting for State differences in output growth rates of food grain crops. In some States, use of modern inputs on an appreciable scale came too late to account for much of the increase in output from 1952/53 to 1964/65. Moreover, fertilizers are distributed to States from a central pool with allocation based on individual State estimates of demand.

Other explanations for the high output growth rates in a few States are differences in investment policies, in effort and initiative, and in pricing and procurement. Admittedly, initiative and effort have been far from uniform from one State to another. Differences among States and districts in

crop output growth rates probably have been affected by differences in agricultural product price, procurement, and distribution policies. If farm products could move freely among States, price and market differences would be relatively unimportant in accounting for interstate differences in rates of growth. Within such a marketing system, growth in demand resulting from growth in population and per capita incomes would generate growth in agricultural output throughout the whole national economy. Because of spatial considerations, increasing geographical specialization (according to the comparative advantage enjoyed by each locality) would have been associated with such growth.

Notwithstanding, food grain procurement and distribution policies pursued over the last 15 years have tended to divide and limit the market. A system of marketing zones, consisting of one State or two or more adjacent States, has restricted the geographical market. This zonal system has thereby distorted otherwise normal interstate differences in prices, depressing food grain prices in surplus-producing States and increasing them in deficit States. Of more serious consequence, it has impeded regional specialization in production and has encouraged increased self-sufficiency or diversification. The State of Kerala, which has long had a comparative advantage in producing such export crops as coconut palms and spices, has allocated more resources to food grain production. States which normally had a comparative advantage in food grain production have been allocating more of their resources to nonfood grain crops like sugarcane and cotton. This tendency has been accentuated by shifts in price ratios favoring nonfood grains over food grains. As a result, India's output of both food grains and nonfood grains has been lower than it otherwise would have been.

A few States like Punjab, Gujarat, Madras, and Maharashtra have had both a comparative advantage in food grain production and a locational advantage (in reference to large rapidly growing markets) for both food grains and farm-produced raw materials. Hence, they have had relatively high rates of growth in agricultural output and productivity. Meantime, nonfarm sectors in these States have contributed to rapid agricultural output growth by furnishing increased supplies of farm production requisites (farm implements and machinery, electric power lines, pump sets), better transportation and storage facilities, and other goods and services.

It is within these market limitations and associated price relationships that some States have exerted greater effort and initiative or excelled in administration, and thus increased agricultural output and productivity more than others. High growth rate districts have also been advantageously placed in reference to farm product markets, modern transport facilities, sources of electric power, and manufacturers of farm implements and other modern inputs.

A NEW ERA IN INDIAN AGRICULTURE

India experienced its worst drought of this century in 1965/66. As a result, agricultural production dropped by nearly 25 percent from the previous record high level of 1964/65 (fig. 30). This drought persisted in India's most populous States, Uttar Pradesh and Bihar, and in large parts of several other States through the 1966/67 crop year, creating what would have been one of the worst famines in history had it not been for massive food aid, mainly from the United States.

Significant from a development standpoint, these 2 years of crisis mark the division between an era of only moderate increases in India's agricultural production and one holding promise of rapid rates of increase in the years ahead.

The new era began with greatly increased emphasis on agriculture in India's economic development plans. Late in 1965, "A New Agricultural Strategy" was announced, emphasizing the rapid adoption of new varieties of wheat, rice, and other cereals that greatly increase crop yields under favorable moisture conditions when large amounts of fertilizers and other complementary inputs are applied. In contrast to earlier policies of allocating inputs to achieve near equal rates of growth in all regions, the New Strategy called for concentrating the use of improved cereal varieties and increased supplies of fertilizers and other yield-increasing inputs in localities and on farms having assured supplies of irrigation water.

Because of the need to increase seed supplies and the continuation of severe drought over large parts of India through 1966/67, the New Strategy was not applied on a large enough scale to affect India's food grain production until 1967/68. In that year, food grain production reached a new high of 96.1 million tons. Unusually favorable monsoon conditions contributed to this record output; however, over half the increase resulted from the new varieties of wheat, rice, and other cereals and the large increases in fertilizer and other complementary inputs.

Accordingly, 1967/68 marked the start in India and other Asian countries of what has been heralded the world over as "The Green Revolution," a break-

through in agricultural technologies adaptable to Asian countries that would soon enable them to solve their age-old problems of hunger and famine. The potentials in India for the continuing rapid spread of improved agricultural technology appear so large that both Indian planners and U.S. observers have indicated that India can increase its food grain output over the next 10 to 15 years by rates of 4.5 to 5 percent per year (41).

With a 5-percent rate of growth, India's food grain production would reach 129 million tons in 1973/74--an increase of 31.2 million tons over the "normal weather adjusted" output of 97.8 million tons in 1968/69. This would represent about as large a tonnage increase in 5 years as India achieved in the 15 years from 1949/50 to 1964/65. It would require the extension of new varieties of rice, wheat, and other cereals from about 8.5 million hectares in 1968/69 to 20 million hectares in 1973/74. Also, it would require the use of 3.1 million tons of plant food nutrients on food grain crops, compared with 1.76 million tons used for all crops in 1968/69. It assumes 29 million hectares of food grain under irrigation in 1973/74, compared with 23 million hectares in 1968/69.

Current estimates indicate that India's food grain output will likely be about 100 million tons in 1969/70, a year marked by generally favorable weather. This would be a new record high, about 6 percent larger than in 1968/69 but only about 5 percent larger than in 1967/68. It is hardly high enough to support the thesis that an early solution of India's age-old problems of hunger and famine now are assured. Much larger improvements in the technological, economic, and

institutional basis of India's agricultural production will be required than are now on the horizon.

The initial rapid spread of the new high-yielding varieties and associated increases in fertilizer and other modern inputs oversimplified the problem of achieving and sustaining annual increases of 4.5 to 5 percent in food grain output. These optimistic projections overlooked the fact that the initial successes were achieved in only a small part of India's total agricultural area under unusually favorable conditions. Because of a large buildup of irrigation works, rural electric power, improved roads, and extension and credit services, it was possible to achieve dramatic successes by extending high-yielding varieties in these areas.

Extending high-yielding varieties to the rest of India will likely require much larger new investments per hectare in improving irrigation and water control systems and in building up rural electric power supplies, agricultural research, education, extension and credit services than have been required in the relatively small and highly select areas to which they have already spread.

Initial successes of the new cereal varieties have had a dramatic psychological impact on Indian planners and farmers in creating a widespread awareness of India's large but yet to be developed agricultural production potentials. They have been less helpful, however, in creating an awareness of the difficulty of achieving and sustaining the rate of growth in India's output of food grains and other agricultural commodities required to meet expanding needs.

The probability that India's present population of 540 million will exceed one billion before the year 2000 is indicative of how rapidly the nation's needs are growing. India must achieve large increases in output per agricultural worker and per hectare. Increasing output per agricultural worker, however, will become increasingly difficult because India's agricultural labor force will continue to grow and the area of land per worker will become progressively smaller. Expected population growth rates and optimistic assumptions about growth in the nonfarm sector's demand

for labor indicate that India will likely have 100 million more workers in agriculture in the year 2000 than it had in 1970.

There is now a great need to critically reexamine and reevaluate India's longrun agricultural production potentials and what must be done to achieve them. Current hopes and official projections may be unrealistic. Excessive optimism may be an obstacle to rapid agricultural development in the 1970's just as it was in the late 1950's and 1960's.

Chapter XI. NIGERIA: PEASANT AND EXPORT AGRICULTURE

By William Huth

All data gathered in Nigeria for the original country study were apparently destroyed in the civil war. Consequently, the author has drawn upon secondary source materials and especially on recent "comprehensive" reports on agricultural development in Nigeria to a greater extent than would otherwise have been the case (29, 40, 62).

BACKGROUND

Formerly a British colony, Nigeria became independent in 1960. It has an area of 350,000 square miles, 3 percent of Africa's land mass (28). The population, which comprises almost one-fifth of Africa's total, is composed of several hundred ethnic groups loosely referred to as tribes. The three major groups are the Hausa-Fulani, Yoruba, and Ibo, concentrated in the north, southwest, and southeast, respectively. Between the heavy population centers of these three groups lies a vast middle belt. This sparsely populated area has much agricultural potential, but at present is infested with the tsetse fly.

Nigeria's natural environment varies from mangrove swamps along the southern coast, through tropical rain forests and derived and natural savanna, to desert near the country's northern border along the Sahara. In general, most of the land is relatively level, with some hills. Climatically, the year may be divided into a rainy and a dry season, with the rainy season becoming progressively shorter as one moves north.

NATIONAL ECONOMIC GROWTH

Nigeria has experienced a generally favorable rate of growth since the 1950's. In real terms, gross domestic product (GDP) is calculated to have grown at a compound annual rate of about 4.1 percent from 1950 through 1957, while the rate from 1958 through 1966 was 5.6 percent (62). ^{19/} About half the growth after 1957 was due to rapid expansion of petroleum exploitation. Agriculture, including livestock, fishing, and forestry, grew 2.8 percent annually from 1950 through 1957, and 3.3 percent from 1958 through 1966 (62). Growth rates for the rest of the economy during these same periods were 6.4 and 9.3 percent respectively, with two-thirds of the acceleration attributable to petroleum production (62). Distribution, manufacturing, and public utilities also expanded.

Although its recorded share of GDP fell from 67 percent in 1950 to 44 percent in 1966, agriculture continued to grow rapidly enough to produce increasing quantities of export crops, and to at least maintain traditional levels of domestic food consumption without increasing dependence on imports (62). About 80 percent of

^{19/} There is a break in Nigerian national account statistics so that figures for periods before 1958 are not readily comparable with those for 1958 and later. Consequently, rates of growth are indicated separately for each period. In addition, there is substantial controversy over population figures used in estimating many national accounts components (4). Except for foreign trade statistics, all figures should only be taken as indicative of overall trends and general magnitudes. The civil war began in 1967; consequently, relevant data beyond 1966 are not available.

Nigeria's active labor force was employed in agriculture in 1963/64 (29).

Rates of growth become more meaningful in terms of real progress when compared with population growth. While Nigerian population data are very rough, they are useful indicators of general trends and relative magnitudes of change (4). Somewhere between 2.5 and 3 percent is usually considered a reasonable estimate of the current population growth rate (29, 53). Based on official figures for 1963 and an assumed growth rate of 2.8 percent, the 1966 population would be about 60 million. Gross domestic product (GDP) in 1966 was \$4,494 million or around \$75 per capita (62). 20/

Nigeria's population is rapidly becoming more urban. The annual rate of urbanization has been estimated at 4.5 percent, much higher than overall population growth (29). The 1963 census shows almost one-fifth of the total population living in communities of over 20,000 inhabitants. The influx of people, especially the young, to the cities has not been paralleled by a concomitant rise in productive employment. Dependence on purchased food has increased, despite the fact that many more "urban" Africans engage in some agricultural production than is common in more economically developed parts of the world.

Population is distributed very unevenly. Aside from the large metropolitan areas such as Lagos and Ibadan in the southwest and Kano in the north, the southeastern areas occupied primarily by the Ibo and Ibibio peoples are the most heavily populated. The north, especially the vast so-called middle belt, is relatively sparsely populated. In 1963, ac-

cording to the most recent census, the average density in the north was around 106 persons per square mile, compared with 420 in the east (62).

Low incomes and very uneven overall distribution of rural population have had important implications for agricultural development in Nigeria. There is limited market demand for traditional staple crops--on-farm consumption is high--while the market for expensive foods is restricted to only the most affluent. Uneven rural population distribution has also led in some areas to serious overcultivation under the prevailing bush fallow cultivation system, discussed on p. 170. At the same time, much potentially productive land is only sparsely populated, but migration to these areas is greatly hindered by cultural restrictions, health problems, lack of adequate drinking water supplies, and poor or nonexistent roads.

HISTORICAL DEVELOPMENT OF AGRICULTURE

In spite of problems such as those indicated above, historically Nigeria's agriculture has at least kept pace with growth of domestic demand. Until the recent exploitation of petroleum, agriculture was the major source of foreign exchange.

After the slave trade was made illegal in 1807, patrols of the British Royal Navy made that occupation increasingly less profitable, and trade in palm oil accelerated rapidly. Rubber became important in the late 1800's, reached a production peak in 1895, and declined swiftly.

20/ At an exchange rate of 1 Nigerian pound=\$2.80.

Major changes in Nigeria's agricultural export economy took place during the first half of the 20th century. After 1914, when good railway connections from the coast were completed, the north began to contribute substantially to the economy with peanuts (groundnuts), hides and skins, and after 1920, with cotton. At the same time, the southwest switched from cotton to cocoa, as the latter became more profitable. Rubber again became important in the southern midwest, while the southeast remained the primary source of oil palm products and exports.

Nigeria's regional export crop economies developed alongside the traditional subsistence economies instead of supplanting them.^{21/} In the south, the subsistence economies were based primarily on the root crops, cassava (manioc) and yams, with sorghum and millet progressively supplanting yams and cassava as one moves north. Additional crops such as corn (maize) and rice are becoming increasingly important.

Urbanization and commercialization of agriculture proceeded more rapidly in the southern forest regions. Combined with a normally higher population density in the south, these factors accelerated the growth of internal agricultural trade with the north. The north (which comprised most of the savanna region and about four-fifths of the total land area) was a substantial net exporter of livestock, cereals, root crops, nuts, and pulses to the southwest, particularly to the large urban centers of Lagos and Ibadan. The north accounted for around 94 percent of

all cattle in Nigeria in 1963/64 (29). ^{22/} On the other hand, the north was a net importer of oils and fats from the southwest and midwest. The southeast's agricultural trade with the rest of the country was approximately in balance (29).

These developments have led to a considerable degree of geographic and ethnic specialization in export crops and to a much lesser extent in domestic staples. Thus, the Yorubas raise cocoa in the southwest, the Edo and other groups produce rubber in the southern midwest, and the Ibo in the southeast represent the major concentration of oil palm production. In the north, the Hausa and other large groups, such as the Nupe and Kanuri, produce most of the peanuts and cotton. Another important export crop, sesameseed, is grown almost exclusively by the Tiv, who live just north of the former eastern region border. The nomadic Fulani of the north are the primary source of beef.

Nigeria's agricultural base is well diversified and, therefore, not overly dependent on the world market situation, diseases, or other factors which might affect certain export crops in a given year. Thus, the overall stability of the economy is much greater than in a country largely dependent on one export crop.

Unlike many other African countries, Nigeria's agricultural economy--both for domestic and export production--is based on peasant producers. This resulted from British colonial land policy, which stressed natives' retention of the land, and

^{21/} Even in the heartland of the cocoa areas of southwestern Nigeria where export crop commercialization is most advanced, only about one family in three grew any cocoa at all in 1956 (34). Nearly all of these relatively commercialized producers also grew staples for their own consumption.

^{22/} Cattle are grazed in the far north, beyond the range of the tsetse fly which covers almost all the rest of Nigeria. The tsetse fly is the vector for trypanosomiasis and effectively prohibits profitable cattle raising where present. Much of the potential sales value of these cattle is lost when they are driven to markets in the south.

from the generally inhospitable climate which discouraged potential Western immigrant farmers from settling in the country.

AGRICULTURAL OUTPUT AND PRODUCTIVITY

Agricultural production for domestic consumption has increased at about the same rate as population growth. Since the 1950's, food imports have typically equaled about 10 percent of total imports by value and around 3 percent of agricultural production. Between 1961 and 1968, consumer price indexes for lower income groups in the major cities of each area, Lagos, Ibadan, Enugu, and Kaduna (allowing for the obvious effect of the civil war on Enugu), rose at about the same rate or slightly less than indexes for all items (65).

Total value of agricultural exports from 1950 to 1965 grew at an annual rate

of about 4.5 percent (53). ^{23/} Except for palm products, physical volumes of Nigeria's major export crops increased faster than population growth (table 60). Peanuts, peanut oil, and palm oil are also consumed in large quantities in the domestic food economy. Exports of palm oil have fallen off considerably with some diversion from the export to the domestic market. However, palm kernel exports, which have no domestic use, also stagnated. In 1962, there was a substantial decline in exports of palm kernels, probably because low producer prices resulting from Government export crop marketing board policies discouraged harvesting. The sudden dropoff of cotton exports after 1963 resulted from substantially increased domestic textile production, not from a large decrease in production.

^{23/} The compound annual rate of growth in value from 1949 to 1966 (least squares) for the sum of the crops shown in table 60 is 3.9 percent.

Table 60.--Nigeria: Compound annual growth rates in volume of exports of major crops, 1949-66

Crop	Annual	..	Crop	Annual
	growth	..		growth
	rate	..		rate
	1/	..		1/
	
		Percent		Percent
	
Cocoa	4.9	..	Cotton	3.3
	
Peanut (groundnut) products:		..	Rubber	2.7
	
Whole nuts	4.9	..	Palm products:	..
	
Oil 2/	1.3	..	Oil	-1.6
	
Cake 3/	2.9	..	Kernels	.1
	

1/ Computed by least squares. 2/ 1949-65. 3/ 1955-65

Source: Computed from data in (62), (63), and (65).

Although adequate supporting data are not available, it would appear that production of domestic staples must have increased at a rate fast enough to feed Nigeria's rapidly growing urban population. Since increased production of traditional food crops for the domestic market cannot be attributed to improved inputs (discussed later) or to an accelerating rate of food imports, more people are apparently farming more land using traditional technology. This in turn implies that the area actually cultivated each year is also increasing at about the same rate as population, or slightly faster. Under bush fallow cultivation, this additional land comes either from bringing virgin land under cultivation or from decreasing the number of years a particular piece of land lies fallow before it is farmed again.

Overall, Nigeria still has much land available, enough to remain self-sufficient in basic food staples for the foreseeable future, even under prevailing technology. Nevertheless, there are local areas where fallow periods have been practically eliminated and soil quality is rapidly deteriorating because of exhaustion and erosion. Consequently, the most critical food problem is not so much one of inadequate quantities of food, but of quality deficiencies, especially protein in southern Nigeria. For example, a nutrition study stated that a well-nourished urban Nigerian child of 4 1/2 years would be 6 inches taller and 9 pounds heavier than a poorly fed child in a rural area (24).

GROWTH OF EXPORT CROPS

Nigeria's export crops remain a major source of foreign exchange. Nigerian peasant farmers readily adopted new or different export crops when they found them profitable. Adoption was

eased because export crops could be produced in addition to traditional food-stuffs by reducing leisure time and so did not constitute any serious risk to the farmers' survival.

In 1900, palm products alone accounted for roughly 85 percent of the total value of recorded exports (40). From 1950 through 1959, agricultural exports were 85 to 87 percent of the value of total exports (66). However, after 1960, agriculture's share of exports fell off rather sharply, due to the increasing importance of petroleum. In 1960, agricultural exports were still around 80 percent of total exports; by 1966, agriculture's share had fallen to about 52 percent. In contrast, petroleum's contribution rose from less than 3 percent to over 32 percent of total value of exports between 1960 and 1966 (53). Thus, Nigeria became much less dependent on agricultural exports for generating foreign exchange.

Nevertheless, export crops continue to be important. They represented 9.2 percent of Nigeria's GDP and 16.6 percent of agricultural gross domestic product in 1966. They are the major source of cash income for millions of peasant farmers and their families as well as the most important source of potential increased incomes and job opportunities in agriculture for rural youth entering the labor force.

Exports of agricultural products and other raw materials gave Nigeria a positive visible trade balance every year after World War II through 1954. These positive balances were achieved in part by a conservative "pay-as-you-go" colonial fiscal policy and a lack of emphasis on development except for important infrastructure investments, such as railroad construction. Generally high export crop prices on world markets also contributed.

In contrast, Nigeria ran a negative visible trade balance every year from 1955 through 1965. This resulted from generally lower world market prices, coupled with a sharp increase in capital goods imports for development. Nigeria drew heavily upon accumulated reserves (of which a large part had originated as market board withdrawals) to finance increased imports. 24/

Since World War II, there have been marked differences in the performances of Nigeria's major export crops. Clearly, peanut products and rubber substantially increased their share of contributions to Nigeria's foreign exchange requirements relative to oil palm products and cotton between 1955 and 1965 (table 61).

Of the five crops considered here, exports of all except rubber have been controlled by marketing boards of one kind or another since approximately the end of World War II. Initially created by the Government to stabilize prices to farmers, the primary function of these boards soon changed to generating revenue for Government purposes. From about 1947 until 1962, marketing boards withdrew over a quarter of the export sales value of cocoa, peanuts, cotton, and palm kernels and oil in the form of duties, taxes, and surplus values. 25/ In 1965/66, total taxes on agricultural products amounted

to about 3 percent of GDP and around 15 percent of the value of agricultural exports from which they were primarily derived (53).

Prices for all these products (except palm kernels) reached unusually high peaks in the early fifties, declining to more normal levels by 1955 (fig. 31). From then until 1966, however, cocoa and cotton prices trended lower, while those of peanuts, palm kernels, and palm oil rose. Prices to farmers followed the general trend of export prices only in the case of cocoa (falling) and peanuts (rising). Prices to cotton producers were roughly constant until about 1960, after which they fell considerably and then remained at the new lower level. While export prices for palm products, especially palm oil, generally rose, producer prices fell steadily until around 1962 when they dropped precipitously.

Rubber, the second major export, is not sold through marketing boards. Its export price rose steadily and rapidly from 1956 to a peak in 1960, then declined by 1965 to its former 1956 level.

Peanut production responded to favorable prices when construction of railroads and the highway system of main and feeder roads spread into new areas of the north. Production expanded with no apparent gain in yields as soon as transportation costs were reduced. In the 1960's, some increases in yields contributed to increased output. 26/ Output also increased due to improved shelling

24/ Nigeria's foreign asset position fell from a high of around £260 million in 1955 to a low of around £80 million in 1964. However, petroleum production more than tripled between 1964 and 1966 (65). But for the civil war, continued expansion of production would have greatly reduced the importance of balance-of-payment considerations as a key factor limiting development.

25/ Helleiner's book, Peasant Agriculture, Government, and Economic Growth in Nigeria, has been particularly helpful in this and the following section (40).

26/ Fertilizer use in northern Nigeria increased from 3,000 tons in 1960 to 35,000 tons in 1967 (53). If total peanut acreage in 1967 were 1.5 million hectares--FAO estimates 1.4 million hectares for 1966 (28)--this would still only represent about 21 kilograms per hectare (19 lbs. an acre) if all were applied to peanuts.

Table 61.--Nigeria: Percentage changes in volume, value, and unit value of crop exports, 1954-56 to 1964-66

Crop	Changes from 1954-56 to 1964-66			Distribution of total value	
	Volume exported	Value exported	Unit value 1/	1954-56	1964-66

<u>Percent</u>					
Peanut (groundnut) products	---	---	---	(30.6)	(37.1)
Whole nuts	28	40	9	25.7	26.9
Oil 2/	162	147	- 3	3.5	6.5
Cake 3/	197	270	24	1.4	3.7
Rubber	135	133	2	4.7	8.2
Cocoa 4/	99	48	- 38	24.0	26.4
Palm products	---	---	---	(33.1)	(25.2)
Kernels	- 7	12	25	19.9	16.7
Oil	- 26	- 14	10	13.2	8.5
Cotton	- 38	- 46	- 14	7.6	3.1
Total	---	34	---	100.0	100.0
...

1/ Unit values are total value of crop exported divided by number of tons exported.
 2/ 1964-65 averages rather than 1964-66. 3/ 1955 rather than 1954-56 and 1965 rather than 1964-66. 4/ 1955-56 average used rather than 1954-56, because the 1954 world price was abnormally high.

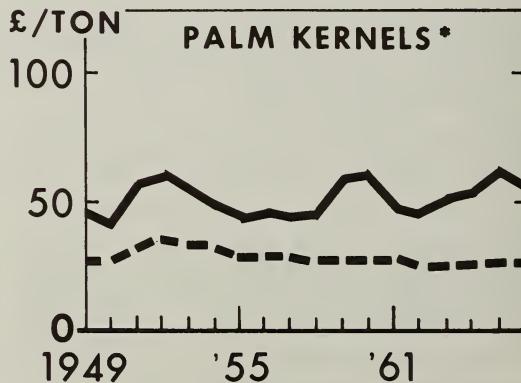
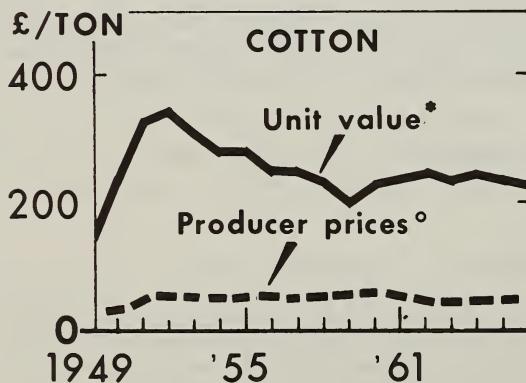
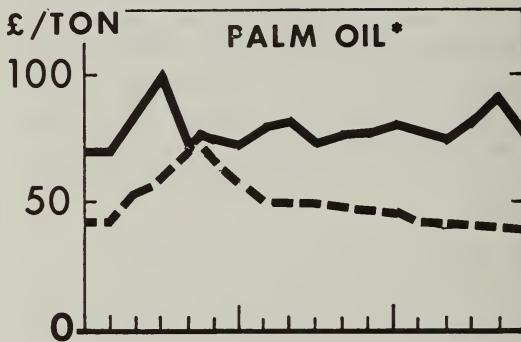
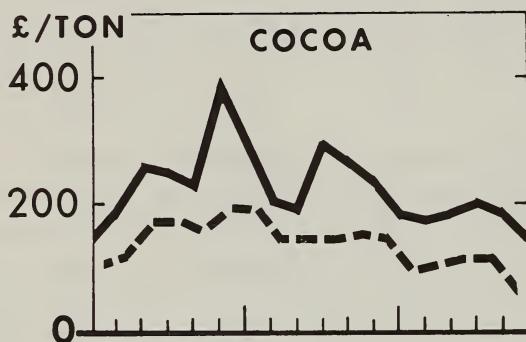
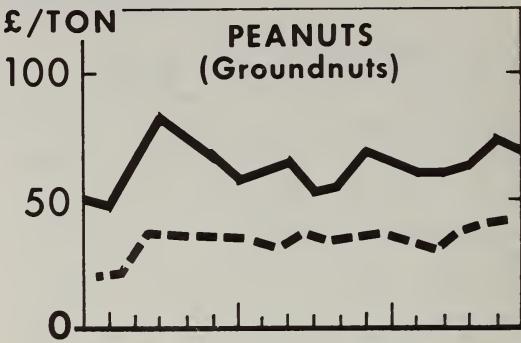
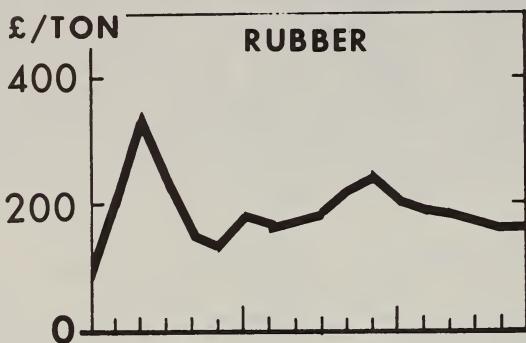
Source: Computed from data in (62), (63), and (65).

methods. Small mechanical decorticators were originally imported, but are now produced locally. With land available and prices favorable, farmers have continually increased areas under production.

Rubber plantings rose in response to high prices in the early 1950's. These plantings were largely responsible for increased output in the late fifties and early sixties. Plantations--far more im-

portant in producing rubber than other crops--account for perhaps 7 percent of the total area under cultivation (53). In general, they are well run and may have important demonstration effects. Government rubber improvement campaigns, started in 1957, have had a part in improving peasant production, maintenance, and harvesting techniques. Relatively better producer prices for rubber have caused some shift in acreage from oil

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* CALENDAR YEAR BASIS.

° CROP YEAR BASIS.

palm into rubber. Nevertheless, the level of technology in Nigerian rubber production is generally very low. 27/

While cocoa production areas have expanded since 1950, increased use of insecticides and fungicides and improved varieties has been credited with increasing yields approximately 50 percent (40). 28/ There is no practical alternative to selling cocoa to the marketing board and since the cocoa belt of southwestern Nigeria is the least self-sufficient area, farmers must harvest the crop to purchase food. This helps explain cocoa's strong export performance, in spite of the unfavorable trend in producer prices.

Cotton is the second most important peasant export crop of northern Nigeria, but with the development of modern textile plants, an increasing volume goes into the domestic market. 29/ Cotton does not compete directly with peanuts because of different soil requirements. As with peanuts, development of transportation facilities encouraged expansion of production, mostly from increased acreages. Government extension programs instituted after World War II have also helped to increase production as have free seed distribution and treatment with fungicides to increase yields.

27/ CSNRD estimates yield for Nigerian rubber in 1966 at about 328 pounds an acre, compared with an average of 1,300 pounds an acre for Firestone plantations in Liberia (53). Quality of Nigerian rubber is also much lower.

28/ First started in 1957, capsid spraying covered about one-third of the entire cocoa belt of western Nigeria by 1963 (40). FAO estimates that between 40 and 50 percent of a 200,000-ton production jump for Africa in 1960/61 may have resulted from increased spraying of trees (29).

29/ In 1966, for example, Nigeria produced about 44,000 tons of cotton lint (raw cotton) and exported about 15,000 tons, or only about 34 percent. Cotton production varies greatly from year to year due to weather conditions.

Oil palm production in Nigeria has several characteristics in common with other export crops. The oil palm is used domestically (like peanuts and cotton) in the form of oil for food, but the kernels (like cocoa) have no domestic use. A major problem (like rubber) is quality control due to poor harvesting and processing techniques. The oil palm typically grows wild, or semi-wild, with no significant production input except labor for harvesting. However, low prices to producers have curtailed oil palm production especially for export. In addition to simply reducing production by harvesting less of the available acreage, farmers have shifted some production from exports to the domestic market in response to better prices. Improved processing facilities have increased extraction rates and quality of oil produced. For example, the screw-type press extracts 65 percent of total extractable oil and the pioneer oil mill 85 percent, as against only 55 percent for traditional methods (40). Low producer prices have also deterred conversion to improved varieties available at the experiment station level.

Critics of export marketing board pricing policies maintain that benefits of Government development activities financed by these funds have not been worth the costs in decreased export crop production and increased rural-urban migration (53).

ROLE OF THE GOVERNMENT IN DEVELOPMENT

Historically, the colonial government restricted itself primarily to maintaining law and order and to providing facilities for transporting export crops and other raw materials from the interior to the coast. Before World War II, the Government constructed over 2,000 miles

of railroad in Nigeria (21). Total road mileage increased from 28,000 miles in 1951 to over 55,000 by 1965. These developments, along with improvement of harbor facilities, were fundamental in facilitating the vast expansion of the export economy.

Another Government activity of major importance to agriculture (aside from the establishment of the marketing boards) was the founding of research stations, such as the Oil Palm Research Station in 1929 and the Cocoa Research Institute in 1951. However, while important progress was made at research stations, extension of results to farmers lagged badly. The extension service promulgated and sometimes enforced Government policies more often than it advised farmers on how to increase productivity.

Emphasis shifted progressively toward development in general, greater emphasis on the industrial sector, and finally to more direct involvement of the Government in commercial operations. According to Helleiner, only about 40 percent of Federal Government expenditures in 1930/31 were developmental (40). Total Federal and regional government expenditures for development purposes in 1960/61 were estimated at £155 million, or approximately 60 percent of total expenditures. Between 1950/51 and 1961/62, major increases went to education and transportation. Education's share rose from 13 to 18 percent and transportation's from 18 to 23.5 percent (40). These figures do not include expenditures by public development institutions which were mainly responsible for the shift in emphasis towards industrialization, or expenditures of such public utilities as the Electricity Corporation of Nigeria or the Nigerian Railway Corporation.

Public development institutions in Nigeria are semiautonomous public bodies. Between 1946 and 1962, these institutions received funds of around £45.8 million. Over 62 percent of this amount was proceeds from marketing board activities (40). Some of these funds were in the form of grants, mostly for agricultural development projects such as farm settlement schemes and transportation facilities such as feeder roads. A relatively small proportion was loaned to individuals, mostly peasant farmers, for productive purposes or to local cooperatives or small Government projects such as pioneer oil mills or woodworking handicraft type establishments. Large loans were also made to private Nigerian companies. Finally, a substantial portion was spent in commercial operations completely financed, owned, and managed by the Government, usually under the auspices of regional development corporations. The most important of these were investments in commercial plantations, followed by investments in Government-owned manufacturing establishments. Of these, commercial tree crop plantations employing modern technology probably will be the most successful. Manufacturing projects--citrus fruit canneries, for example--have usually failed.

Of a total of £39.4 million spent by regional development institutions for development purposes by 1962, about 34 percent was in long-term loans to relatively large Nigerian companies. Thirty-five percent was invested directly in Government-commercial schemes (40). In contrast, a little over 6 percent was loaned to individual farmers for productive purposes (40). These loan programs for individual farmers were generally unsuccessful, due to management and administration problems, lack of adequate securities for loans, and loans used for

other approved purposes. 30/ Nevertheless, agriculture's share of total (Federal and regional) Government expenditures from 1950 to 1962 amounted to less than 5 percent (40).

In the 1962-68 National Development Plan for Nigeria, agriculture's share of the allocations was about £91.8 million, or approximately 13.5 percent of the total (53). This is roughly three times the previous rate, but again, over 34 percent of these funds were allocated to Government-directed agricultural projects (53). The most significant of these projects from a policy standpoint probably were the farm settlement schemes of southern Nigeria. Major objectives of these tree farm schemes include testing and demonstration of carefully planned farm systems, administration of pilot supervised credit schemes, and training of young farmers who would either remain on settlements or return to their villages equipped with new skills. An additional objective, especially in western Nigeria, was to provide employment to young people leaving school to prevent their migrating to congested urban areas. It is generally conceded that these schemes, not only in Nigeria but also in other parts of Africa, have not usually been very successful, either in terms of economic profitability or other special objectives (24).

Extension service functions have evolved since World War II to include more activities such as dispensing information and instruction on improved production practices. However, extension

30/ Helleiner, describing the situation in southeast Nigeria as representative, states that of 391 loans issued (a very small number considering the number of farmers in the region) by 1962, about one-third were in default. It should be kept in mind that land tenure systems in Nigeria do not permit the use of land as collateral (40).

service functions still range from supplying peasant producers with production requisites, especially during production campaigns, to running farm settlement schemes. A major reason for extension service involvement in such activities is the lack of development of private enterprises to provide production requisites. 31/ One-fourth to one-half the extension agents' time may be accounted for by such nonextension type activities as direct production and research duties and work connected with farm settlement schemes (29)

Major improvements in basic health and education have increased agricultural productivity to some extent. Major emphasis so far has been on large-scale disease-preventive health measures and on general education, as opposed to technically oriented education.

Government development activities have aided agricultural development in Nigeria, especially in the export crop sector where almost all research and most specific efforts such as "production campaigns" have been directed. Probably the most important Government contribution to date has been the transportation infrastructure making export crop production profitable for farmers.

AGRICULTURAL TECHNOLOGY

Nigeria's peasant farmers have increased production, especially of export crops, by increasing labor inputs and decreasing leisure-time activities. Except for greater use of improved export crop

31/ A major reason for the success of the improved corn (maize) production program in Kenya was the prior existence of a private commercial grass seed distribution company onto which the improved maize seed program could be grafted. Apparently, no counterpart to this company exists in all of West Africa.

varieties and widespread spraying of cocoa stands in the southwest, use of improved technology has been very limited. Little has been done to upgrade domestic staple varieties, but greatly improved varieties of important export crops are available at research stations. The oil palm is an outstanding example. About 90 percent of Nigeria's oil palm production comes from semi-wild trees which produce about 1 ton of palm bunches per acre. Improved varieties are available which produce 6 tons an acre under experiment station conditions and 3 tons an acre under peasant production (53).

At present, the task of transmitting seedlings of improved varieties to the farmers, along with the necessary package of other production requisites, technical knowledge, and incentive-developing information, rests almost exclusively with Government agencies--especially the extension services. It is estimated that there is only about one extension agent for every 2,000 farming families in Nigeria, and in many places the ratio may be in the neighborhood of 1:5,000 (29). Two possible ways to improve this situation would be to concentrate activities of extension agents on a limited number of farmers or to involve private enterprise in certain activities now carried on by the extension service.

For profitable results, new crop varieties usually require improved cultivation practices and new production inputs, especially fertilizer. It has been estimated that approximately 20 million acres of Nigeria's total 225 million acres of land were actually farmed in 1965 (69). Based on FAO fertilizer consumption figures (28), this implies overall application rates of less than 0.2 pound per acre for nitrogen and P_2O_5 , and less than 0.1 pound per acre for K_2O . Clearly, use of fertilizer has hardly reached the token level in Nigeria.

Although new technology has been important in improving export crops, increases in agricultural output--especially for subsistence crops--have come primarily from larger inputs of traditional technology, particularly human labor. Animal and tractor power are insignificant in the production process, although animals (especially asses) are used in the north for transporting people and goods. In 1967, there were only 256 tractors of all kinds in Nigeria, and most of these were in use in Government programs (28).

Most production is on small peasant holdings. In the north, southwest, and southeast, approximately 42, 78, and 89 percent, respectively, of the farmers cultivate less than 2.5 acres of land. In the north, only about 9 percent of the farmers cultivate over 10 acres each and in both southern regions, the percentage drops to less than 1 percent (64, 65).

Farms are cultivated under a bush fallow system. Fields are rotated between alternating periods of cultivation and fallow, rather than permanently cultivated. The fallow period is to restore fertility to the tropical soils which leach rapidly. In certain areas, especially in the east, persistent population pressure has shortened fallow periods. In these areas, the soil is "mined" rather than farmed, and soil erosion and exhaustion are serious problems.

Land and labor requirements are usually carefully integrated, and crops are often planted in mixtures rather than singly in any given field. Livestock, primarily goats and chickens, simply exist on what they can forage for themselves.

Livestock and economic trees are the major capital assets, supplemented by planting materials and simple structures and handtools. By and large, all such

inputs are unimproved in any meaningful sense. Tools are primitive, livestock are low-producing native breeds, seed is from unimproved varieties, and trees are often wild, self-seeded native types.

Subsistence crops not directly consumed are sold in the local markets. These markets normally are open for business only every fourth or fifth day. Market days are staggered so a villager can walk to some market on any given day. A fairly competitive situation exists in the local markets, although prices may vary considerably from market to market. Produce bought and sold is often carried for miles by headload, usually by women, although bicycles and lorries are also common means of transportation. Most major crops sold for export are marketed by the farmers directly or through middlemen to statutory Government marketing boards.

These economic activities are carried out by villagers in the context of slowly evolving traditional tenure systems. In Nigeria, much land is regarded as joint community (village) property. The cultivator has temporary use rights to an assigned portion of land. When the fallow period starts, such land reverts to the community pool. Land not regarded as joint community property is usually held by the extended or nuclear family, whose ownership rights over it approach a "fee simple" situation. However, under customary law, no land

may be permanently alienated from the community without its consent. These systems of communal tenure are breaking down in some areas where population pressure is heaviest, but are dominant over all of rural Nigeria.

Many specific problems, actual or potential, are associated with these tenure systems, including land fragmentation and maldistribution, prohibitions against certain production practices, and lack of incentives to make permanent improvements.

It is on this traditional agricultural base that Nigerian planners must build a modern agriculture.

SUMMARY STATEMENT

The past record indicates that Nigeria's peasant farmers respond to economic incentives. Agricultural development will probably be more rapid and the gains from it more widely distributed if, wherever feasible, the Government facilitates further development by these farmers instead of engaging directly in the production process.

For the future then, emphasis should be on policies to provide incentives and aid to farmers so they can take advantage of profitable opportunities to grow crops for export or to supply food products to rapidly growing urban areas.

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